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CALVIN HENRY KAUFFMAN

E. B. MAINS

(WITH PLATE 6)

Calvin Henry Kauffman was born March 1, 1869, on a farm near Lebanon, Pennsylvania. Here his close contact with nature early developed an interest in botany. While still in prepratory school he studied the flora about Lebanon and started his herbarium of flowering plants. However, during his undergraduate years at Harvard, he specialized in languages and devoted but little attention to science, taking three courses in chemistry and one in botany. He received the A.B. degree from Harvard in 1895.

Following his graduation, he taught for several years in the public schools of Pennsylvania, Indiana and Illinois. In 1900, while teaching in a normal school at Bushnell, Illinois, his scientific inclinations were stimulated, apparently as a result of giving a course in chemistry. Also at this time he obtained a copy of Atkinson's "Mushrooms" and spent many happy hours studying the agarics of the vicinity. As a result, he decided to specialize in science and spent the following year (1901–1902) at the University of Wisconsin where he took courses in botany and chemistry. Here he came under the influence of Professor R. A. Harper, and through him became interested in and started his studies of the Saprolegniaceae.

The following two years (1902–1904) were spent at Cornell University where he was a personal assistant to Professor G. F. Atkinson. He seized the opportunity thus offered to study agarics and spent a considerable portion of his time on that

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group. Encouraged by Professor Atkinson, he devoted special attention to the genus *Cortinarius*.

In 1904 he accepted an instructorship in the department of botany of the University of Michigan. Here he continued his studies, both in the Saprolegniaceae and Agaricaceae. In 1907, he received the degree of Ph.D. from the University of Michigan. He presented a dissertation entitled "A Contribution to the Physiology of the Saprolegniaceae, with Special Reference to the Variations of the Sexual Organs."[1] In this study he was successful in showing that reproduction in the Saprolegniaceae could be controlled with remarkable accuracy by the use of proper nutrient media. In this his results were in agreement with the results and theories of Klebs. These principles influenced to a marked degree all his future physiological studies.

During his early years at Michigan he threw himself enthusiastically into the study and development of cryptogamic botany. For a number of years he taught courses in algae, mosses and ferns, general and advanced mycology and pathology, and forest pathology. During his later years he limited his teaching largely to mycology and forest pathology. He was an enthusiastic and inspiring teacher, and had the ability to transmit his enthusiasm to his students to a remarkable degree.

He was much interested in the growth of the herbarium at Michigan. He not only added his own extensive collections, but also devoted much time to planning and supervising its development. In 1921 he was made director. It grew rapidly and in 1928 moved into more commodious quarters in the Museums Building, becoming one of the University Museums. In 1928 he was able to announce the acquisition of the extensive Krieger Mycological Library and Collections, a gift of Dr. Howard A. Kelly. The following year he still further added to the facilities by the purchase of the lichen herbarium and library of Professor Bruce Fink. Unfortunately, he did not long enjoy the facilities that he had worked so hard to create.

Doctor Kauffman published 42 papers,[2] mostly on mycological subjects. His most extensive and outstanding publication is

[1] Ann. Bot. **22**: 361–387. 1908.

[2] A complete bibliography is given in Phytopathology.

"The Agaricaceae of Michigan"[3] in which he described 884 species of agarics illustrated with 172 plates. It is remarkable for its clear descriptions and critical delimitation of species. He also has monographed the genera *Armillaria*,[4] *Inocybe*,[5] *Lepiota*,[6] *Gomphidius*,[7] *Flammula* and *Paxillus*,[8] and *Clitocybe*.[9] He described more than 200 new species of fungi, from not only the Agaricaceae but also many other groups.

He was much interested in the flora of Michigan and was one of the principal contributors to our knowledge concerning it. He was also specially interested in the flora of the Rocky Mountains and the Pacific Northwest and spent many summers with his students in Washington, Colorado, Idaho, Wyoming and Oregon. He also spent one summer in Tennessee and Kentucky, and another in North Carolina and Tennessee. The results of these studies have been published in the Papers of the Michigan Academy of Science, Arts and Letters. He had planned critical studies of a number of other genera of the Agaricaceae, and left manuscripts in various stages toward completion. His death is a distinct loss to mycology. He has enriched our knowledge of the fungi of North America, and by his critical studies has established bases for future investigations.

Doctor Kauffman was advanced from the rank of instructor to that of assistant professor in the University of Michigan in 1912, associate professor in 1920 and professor in 1923. He was made professor emeritus and director emeritus in January 1931 following his illness. He died at the age of 62 at his home in Ann Arbor, Michigan, June 14, 1931. He is survived by his wife Elizabeth Catherine Kauffman.

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[3] Mich. Biol. and Geol. Surv. Publication 26, Biol. Surv. 5, Lansing, Michigan. 1918. Vol. I, 924 pages. Vol. II, 172 plates.

[4] The Genus *Armillaria* in the United States and its Relationships. Papers Mich. Acad. Sci. Arts and Letters **2**: 53–66. 1922.

[5] *Inocybe*. N. Am. Fl. **10**: 227–260. 1924.

[6] The Genus *Lepiota* in the United States. Papers Mich. Acad. Sci. Arts and Letters **4**: 311–344. 1924.

[7] The Genus *Gomphidius* in the United States. Mycologia **17**: 113–126. 1925.

[8] The Genera *Flammula* and *Paxillus* and the Status of the American Species. Am. Jour. Bot. **13**: 11–32. 1926.

[9] The Genus *Clitocybe* in the United States with a Critical Study of All the North Temperate Species. Papers Mich. Acad. Sci. Arts and Letters **8**: 153–214. 1927.

OBSERVATIONS ON THE AQUATIC FUNGI OF COLD SPRING HARBOR [1]

F. K. Sparrow, Jr.

(With Plates 7 and 8 and 4 Text Figures)

Introduction

Inasmuch as the region around Cold Spring Harbor, L. I., has long been, and will continue to be, the site of various types of biological investigation, it seems fitting to add to the fund of knowledge already accumulated certain observations on a group of little known aquatic fungi which apparently abound in the fresh water lakes of that vicinity. The observations herein described, which have been pursued over a period of four summers in the interim of teaching duties, have proved to be of more than local interest, for many of the species found apparently have never, heretofore, been reported as occurring in North America.

Few investigations of a similar nature have been undertaken in this country (Coker, Couch, et al.; Graff). With the exception of Couch's paper reporting various saprolegniaceous forms found at Cold Spring Harbor (**9**), the localities previously investigated by other workers have been relatively remote from the present one. Several other papers on aquatic fungi are monographs of particular groups (Humphrey (**13**), Kanouse (**14**)). These, and the occasional papers of Thaxter, Karling, and a few others, represent nearly our entire knowledge of the aquatic fungi of this country. In Europe, a number of such papers have been published (A. Braun, Zopf, Fischer, Minden, Sorokin, Dangeard, deWildeman, Apinis, Petersen, Scherffel, Valakanov, Tiesenhausen, etc.) although even there the amount of investigation accorded these fungi has not been adequate.

One very well known group of aquatic Phycomycetes has been given scant attention in this paper, namely, the Saprolegniaceae.

[1] The preparation of this paper has been greatly facilitated by the kindness of the Board of Trustees of Dartmouth College in granting the writer leave of absence in order to accept a National Research Fellowship.

This has not been due to the lack of these organisms in the region, but rather to the writer's greater interest in the lesser known algal and twig-inhabiting forms. A few of the more interesting of the Saprolegniaceae have, however, been included. Couch (**9, 10**) has recently secured a number of interesting members of this group from the vicinity of Cold Spring Harbor.

It should be emphasized at this point that this paper is primarily a taxonomic one and not an attempt to give the complete, detailed morphology and development of each of the fungi herein mentioned. Certain phases, however, which are essential to the proper identification of a particular organism, are in some cases dealt with in detail.

MATERIALS AND METHODS

The fungi described in this paper were all found in the immediate vicinity of the Biological Laboratory of the Long Island Biological Association at Cold Spring Harbor, N. Y. Other stations in the United States where these fungi have been collected by the writer, or by other investigators, are also included in the data.

Several methods of procedure were followed in obtaining material. Algae, submerged twigs, apples, etc., were brought in from their aquatic habitats and immediately examined for fungi which might be present. A second method involved bringing in this material and, after an immediate examination for fungi, placing it in sterile, distilled water and examining it at intervals. Often, fungi which were present on the substratum at the time of collection, but were not visible, would, under these conditions, produce an abundant growth. Various types of bait were left in pools and collected sometime later and the fungi thus obtained, studied. Another method was to collect sphagnum, or trash of various sorts from aquatic habitats, seal it up in waxed cardboard containers, and send it to the laboratory where one was working. The material was then placed in jars in a suitable amount of sterile distilled water. The water cultures thus obtained were then baited with various types of animal and vegetable substrata. In addition, the algae which invariably develop in such cultures when there is a sufficient amount of

light would often be attacked by chytridiaceous organisms. By this method, representatives of the flora of a locality could be studied, even though one was at some distance from the site.

In identifying the fungi found by the aforementioned methods, the monograph of the aquatic Phycomycetes by Minden (**20**) was used. Determinations were supplemented in all cases by comparisons with the original descriptions. Later treatments of special groups were also consulted.

OBSERVATIONS AND RESULTS

CHYTRIDIALES

FAM. WORONINACEAE

OLPIDIOPSIS SAPROLEGNIAE Cornu (sensu lat. Barrett), Ann. Sci. Nat. V. **15**: 145. 1872. Barrett, Ann. Bot. **26**: 232. 1912. *Olpidiopsis echinata* Petersen, Ann. Myc. **8**: 540. 1910.

A form, at first considered *O. echinata*, was found parasitic in *Achlya*, in 1927. After a perusal of Cornu (l.c.), Barrett (l.c.), and Petersen's (l.c.) papers, the writer does not feel that there are sufficient grounds for the latter investigator's fungus remaining as a distinct species and it is therefore merged with *O. Saprolegniae*.

The sporangia are elliptical to sub-spherical, 45–50 × 30–36 μ, with a single tube of discharge, usually about 48 μ long and about 5.4 μ in diameter. The zoöspores are biciliate and about 2.5–3 μ in length. The resting spore is usually about 47.3 μ in diameter and is beset with slender spines 5.3 μ in length (TEXT FIG. 1, C); the companion cell, of which only one was attached to an "oögonium" in this material, is smooth, and about 25.5 μ in diameter. The resting spore with a tuberculate outer wall, ordinarily described as that of this species, is, as Barrett has shown, different from Cornu's fungus and has been termed *O. vexans* Barrett (**12**).

In filaments of *Achlya* sp.(?), Jarvis Pool, June, 1927. New York (Barrett). Coker's fungus (**7**) seems to be *O. luxurians* Barrett.

OLPIDIOPSIS MINOR A. Fischer, in Rab. Krypt.-Fl. 1^4: 39. 1892. *Olpidiopsis fusiformis* Cornu, pro parte (l.c.), *p. 147, pl. 4, figs. 3a and 4.* Reinsch, Jahrb. Wiss. Bot. **11**: 304. 1878, *pl. 17, fig. 1.*

The distinguishing feature of this species is its coarse, abruptly tapering spines as compared with the slender ones of the preceding species and of *O. luxurians* Barrett. These resting spores are 34.5–52.6 μ in diameter and the spines are about 10.5 μ in length (TEXT FIG. 1, F, G). The companion cell, which is smooth, is about 18.5 μ in diameter. The sporangia of this

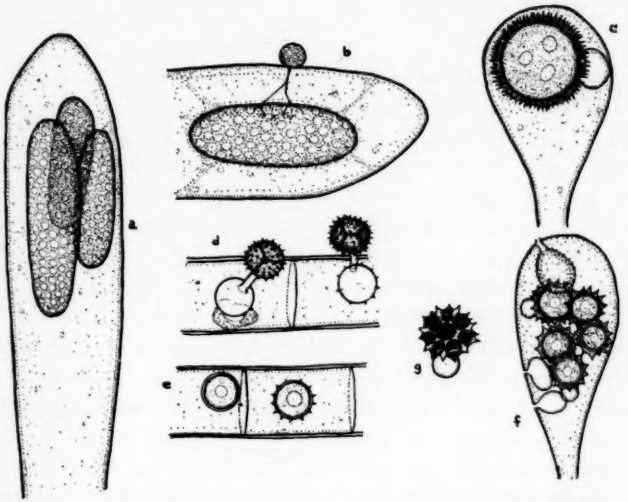

FIG. 1. (a) *Pseudolpidium fusiforme.* Immature sporangia in filament of *Achlya* (× 365). (b) *Rhizophidium carpophilum.* Nearly mature sporangium; parasitic in *Olpidiopsis*, which in turn is parasitizing *Achlya* (× 365). (c) *Olpidiopsis Saprolegniae.* Resting spore and companion cell in *Achlya* (× 260). (d) *Micromycopsis cristata* var. *minor* n. var. Extramatrical, spiny sori produced by germinating, intramatrical resting spores (× 670). (e) Resting spores of same fungus (× 670). (f) *Olpidiopsis minor.* Habit of resting spores and sporangia in *Achlya* (× 260). (g) Resting spore and companion cell of same fungus in surface view.

fungus were found in the same cells as those which contained resting spores. These sporangia were 21.7 μ long by 10.4 μ in diameter (although these dimensions varied somewhat), and were sometimes beset with very tenuous spines. The discharge tube, through which the biciliate zoöspores were discharged, was about 2.6 μ in diameter and varied slightly in length (TEXT FIG.

1, F). Fischer (l.c.) states that the sporangia of this species are small, while Butler (**4**) describes them as being large, spherical, and 80–120 μ in diameter. Neither mentions spines as being present. While it is possible that we may be dealing with a distinct species in the present instance, in view of the variation in echinulation found among sporangia of the American material and the variations in size of the sporangia of other species reported by Barrett, specific distinction does not seem warranted at this time.

The fungus figured by Petersen (l.c. FIG. 18, G) possesses too many and too slender spines to be this species and probably should be referred to *O. luxurians* Barrett (cf. Barrett's PL. 23, FIG. 21, B). The form found in India by Butler (l.c.) agrees with the present material with respect to the resting spore, but, as has been stated, possesses somewhat larger sporangia. Reinsch (l.c.) figured sporangia similar to those of the Cold Spring Harbor material, with respect to shape. Minden (**20**) and Fischer have indicated that they regard the sporangia figured by Reinsch as those of *Pseudolpidium fusiforme* (Cornu) Fischer, but the writer can find no evidence, other than a slight similarity in shape, to support this view. From observations on the development, discharge, and size of these sporangia, similar to those found by Reinsch, the writer is convinced that these are the sporangia of *O. minor*.

Parasitic in filaments of *Achlya* and *Saprolegnia* spp.(?), various pools and springs in the vicinity of the Laboratory, August, 1930.

PSEUDOLPIDIUM FUSIFORME (Cornu) Fischer, l.c. p. 35.
Olpidiopsis fusiformis Cornu, l.c. p. 147, pro parte, *pl. 4, figs. 1–3s.* (Not the resting spores.)

The vegetative stage of this fungus is quite characteristic and the large elliptical bodies (TEXT FIG. 1, A) which will become sporangia are found quite commonly in various saprolegniaceous forms. The sporangia vary somewhat in size, being in the present material about 105–131 μ long, by 26–31 μ in diameter. The resting spores, which were not observed, are said by Fischer (l.c.) to resemble the sporangia in shape, and to be beset with numerous spines.

Parasitic in *Achlya* and *Saprolegnia*, Jarvis Pool, 1927.

WORONINA POLYCYSTIS Cornu, l.c. p. 176.

Both the clusters of spherical sporangia contained in walled-off portions of the host and the erumpent "cystosori" were observed in filaments of *Achlya*. The parasite produced a marked hypertrophy of the host cell which involved a pronounced swelling of the infected parts. Unfortunately, the figures and measurements of this and the succeeding fungus, with which it occurred, have been lost, but from other notes taken at the time and from personal recollection, the identities of these two fungi are expressed with certainty.

Parasitic on *Achlya* sp.(?), Jarvis Pool, 1927.

ROZELLA SEPTIGENA Cornu, l.c. p. 163.

This fungus was found, along with the preceding one, infecting filaments of *Achlya*, in which it produced a linear series of sporangia blocked off from each other by cross walls laid down by the host. In contrast to the preceding species, the sporangia of this fungus occupied the whole of the blocked-off portion of the host cell. No resting spores were observed.

Parasitic in *Achlya* sp.(?), Jarvis Pool, 1927.

FAM. SYNCHYTRIACEAE

Micromycopsis cristata var. **minor** Sparrow, var. nov.

The genus *Micromycopsis*, based on *M. cristata*, has recently been erected by Scherffel (**24**) to include those *Micromyces*-like forms which, upon germination of the pro-sorus, produce a short tube through which the content of the fungus passes to the outside of the host cell. There it becomes invested with a membrane, which in the present species is covered with spines. From this body, upon germination, there is produced, according to Scherffel, amoeboid spores, which, he thinks, probably give rise in turn to motile spores. Just what happens in the germination of the sorus and sporangium is not clear from Scherffel's account, and, as the present writer observed no germination of the sori, he can add nothing at this time concerning this point.

The pro-sorus within the host cell was spherical and possessed a thick brown wall which was beset, in most instances, with a

helicoid series of spines (TEXT FIG. 1, E). These bodies were 8.5–10.4 μ (usually about 8 μ) in diameter, which was smaller than that given by Scherffel (11–20 μ, mostly 14 μ). The extramatrical, spiny-walled sorus upon germination undoubtedly splits along the sutures which are visible in the mature resting sorus (TEXT FIG. 1, D). In some sori it is possible to observe that the content, before germination, has separated into three tetrahedral portions. Further phases in the germination did not take place, and the fate of the sporangia, while they will probably behave as those of *Micromyces*, must await further investigation. The sorus was consistently about one-half the size of *M. cristata* (7.8 μ in diameter vs. 14 μ). Such a constant discrepancy in size, in view of the lack of evidence from cross inoculation experiments on different hosts and resulting data on variations in size, etc., seems of little significance in segregating the present fungus as a new species. It does, however, seem worthy of recognition as a variety, and the name *minor* is therefore proposed for it.

It is quite possible that in the future when more organisms similar to *Micromycopsis* and *Micromyces* have been investigated in detail, the former genus may be found to be superfluous.

FAM. RHIZIDIACEAE

PHLYCTIDIUM LATERALE A. Braun, Abh. Akad. Berlin **1855**: 41.
Chytridium laterale Br. (l.c.).
Rhizophidium laterale (Br.) Raben. Flor. Eur. Alg. **3**: 281.

The spherical extramatrical sporangia of this fungus (TEXT FIG. 2, G) were 10–14 μ in diameter and possessed a single, somewhat irregular, inflated "rhizo-haustorium," 2–4 μ in diameter, which penetrated deep into the zygote of the alga. The zoöspores were formed within the sporangium and were discharged upon the deliquescence of a sub-apical papilla, one by one, in typical *Rhizophidium*-like fashion. They are of the uniciliate, chytrid type.

The haustorium of this species, as figured by Braun (l.c. PL. 3), is shorter and straighter than the present form, but this seems a minor difference. The papillae of Braun's fungus were usually more laterally placed than those found on the American material,

but variations in this respect are found even in the original figures of this species (cf. Braun's PL. 3, FIGS. 23, 25). The form termed *Rhizophidium carpophilum* by Coker (7) probably is this species.

Parasitic in zygote of *Spirogyra* sp.(?), Fish Hatchery, 1927.

RHIZOPHIDIUM POLLINIS (A. Braun) Zopf, Abh. Nat. Ges. Halle **17**: 82. 1888.

Chytridium pollinis Pini A. Br., Monatsber. Akad. Berlin **1855**: 381. Abh. **1855**: 40.

Chytridium vagans A. Br., Monatsber. Akad. Berlin **1856**: 588.

This is perhaps the most common and most easily obtained of all the chytrids. It occurs commonly on pine pollen which has

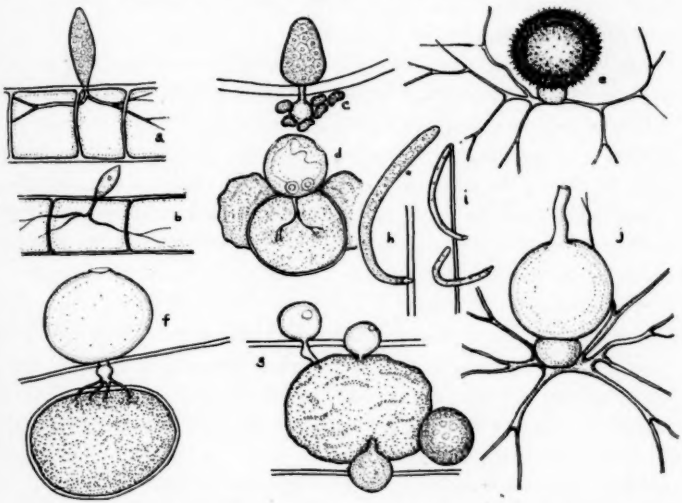

FIG. 2. (a) *Rhizophidium Fusus*. Habit of plant in *Melosira* (× 670). (b) Smaller sporangium of same fungus in a smaller species of *Melosira* (× 670). (c) *Phlyctochytrium Hydrodictyii*. Mature sporangium, parasitic in *Rhizoclonium* (× 750). (d) *Rhizophidium pollinis*. Discharged sporangium, parasitic in a pollen grain (× 375). (e) *Diplophlyctis intestina*. Resting spore in *Nitella* (× 670). (f) *Rhizophidium vernale*. Discharged sporangium, parasitic in zygote of *Spirogyra* (× 580). (g) *Phlyctidium laterale*. Sporangia, parasitic in zygote of *Spirogyra* (× 580). (h) *Harpochytrium Hedenii*. Sporangium on *Oedogonium* (× 670). (i) Same fungus, on *Spirogyra* (× 670). (j) *Diplophlyctis intestina*. Discharged sporangium, in *Nitella* (× 670).

fallen in the water, but has also been reported on pollen of other types. The sporangia are spherical, extramatrical, 18–26 μ in diameter, and possess a sparingly branched, intramatrical, rhizoidal system (TEXT FIG. 2, D). The zoöspores which are uniciliate with a prominent oil globule, are about 3.5 μ in diameter and escape from the sporangium through several sub-apical pores. Thick-walled extramatrical resting spores, the same size as the sporangia, with a large oil globule, are often found.

Saprophytic in pine pollen, Second Lake, 1928; Fish Hatchery, 1929; Cambridge, Mass., 1929; Hanover, N. H., 1930: Wisconsin (Melhus); Montana (Graff).

RHIZOPHIDIUM FUSUS (Zopf) Fischer, l.c. p. 99.

Rhizidium Fusus Zopf, Nova Acta Akad. Leop.-Carol. **47**: 199. 1884.

Sporangium narrowly to broadly fusiform, nearly always slightly tilted; 10.4–20 μ long by 3–8 μ in width; extramatrical; rhizoidal system stout, especially at the base of the sporangium, extensive, ramifying in many cases through 5–6 cells of the host and causing a pronounced disintegration of the content of the latter (TEXT FIG. 2, A, B). The zoöspores are very minute, 2–2.5 μ in diameter, each with a single cilium and an oil globule. They escape from the sporangium through an apical pore.

As has been suggested by Fischer and Minden (**20**), this species is doubtfully distinct from *R. lagenula* (A. Br.) Fischer. Indeed, save for the more fusiform shape and tilting of the sporangium, the writer can find no distinction between them. However, these two characters seem sufficiently distinctive and constant to maintain Zopf's species.

Parasitic in *Melosira* spp., Fish Hatchery, 1930.

(?) RHIZOPHIDIUM CARPOPHILUM (Zopf) Fischer, l.c. p. 95.

Rhizidium carpophilum Zopf, l.c. p. 200.

A form which seems morphologically to agree with Zopf's fungus was found parasitic in *Olpidiopsis Saprolegniae*, which in turn, was parasitizing a species of *Achlya*. The spherical, extramatrical sporangium was about 12–20 μ in diameter and possessed a slender intramatrical rhizoid, which was rarely branched (TEXT FIG. 1, B). As no zoöspore emergence was observed, the

positive identification of this species could not be made; however, from its dimensions, rhizoidal system, and habitat, this form closely resembles Zopf's species. Coker's fungus of this name appears to be a *Phlyctidium* (**7**).

Parasitic in *Olpidiopsis Saprolegniae* (sporangium), Jarvis Pool. 1927.

Rhizophidium vernale (Zopf) Sparrow, comb. nov.

Rhizidium vernale, Zopf, l.c. p. 234, description of pl. 10, figs. 12–20; (no description in text).

Phlyctochytrium vernale (Zopf) Schröter, E. & P. Nat. Pfl. **1**[1]: 78. 1892.

Sporangium extramatrical, spherical to sub-spherical, 20–25 μ in diameter; opening by an apical papilla, allowing the fully formed zoöspores to escape. The latter are spherical, uniciliate, and possess a refractive oil globule. The rhizoids of this fungus are stout, and near the point of attachment to the sporangium, before branching has occurred, the main "trunk" may be slightly inflated (TEXT FIG. 2, F).

This fungus was placed by Schröter (l.c.) in *Phlyctochytrium*, along with the other species of Fischer's genus *Rhizidium*, and was retained there by Minden, because of the slight inflation of the unbranched portion of the rhizoid. The latter structure is, indeed, as Minden (**20**) says, ". . . nur noch als schwache Anschwellung. . . ." To the writer's mind, it would seem better to place this form in *Rhizophidium*, as the inflation of the rhizoid, while sufficient to distinguish this form from other uniporous species, is not so convincing a generic character in this instance.

Parasitic in the zygote of *Spirogyra* sp.(?), Fish Hatchery, 1927.

PHLYCTOCHYTRIUM HYDRODICTYII (A. Braun) Schröter, l.c. p. 78.

Chytridium Hydrodictyii A. Braun, Monatsber. Berlin Akad. **1855**: 383.

Rhizidium Hydrodictyii (Br.) Fischer, l.c. p. 108.

The pyriform sporangia of this fungus were extramatrical, 15 μ long by 5–10 μ in diameter (TEXT FIG. 2, C). Within the host cell a definite, spherical, subsporangial swelling, about 5 μ in diameter, was always present. No rhizoids could be detected

in the dense content of the infected alga, nor were any observed on the somewhat larger sporangia figured by Braun. The zoöspores of our species were about 3 μ in diameter and escaped, fully formed, by means of the deliquescence of an apical pore, as in *Rhizophidium*. These spores were similar to those of the latter genus.

To the writer's mind, this fungus is a true *Phlyctochytrium*, applying this generic term in its strictest sense.

Parasitic in *Rhizoclonium hieroglyphicum*, Fish Hatchery, 1927; Cambridge, Mass., 1928.

PHLYCTOCHYTRIUM PLANICORNE Atkinson, Bot. Gaz. **48**: 337. 1909.

The sporangia of this species, when mature were about 8 μ long by 6 μ in diameter, and each possessed at its apex, four plain teeth. These dentations were not bipartate, as have been figured by deBary and Rosen (**23**) for *P. Zygnematis*, *P. dentatum*, and *P. quadricorne*. At the base of the sporangium, within the host cell, there was a definite swelling, which varied from a pronounced fusiform enlargement to a well formed, spherical structure. Gradations from one to the other of these shapes were often observed on sporangia occupying a single algal filament (TEXT FIGS. 3, E, F, G, K). The rhizoidal system which emanated from the sub-sporangial swelling was extremely variable in the amount and extent of its branching (TEXT FIGS. 3, G, J).

The zoöspores, which are partially formed within the sporangium, are finally fashioned outside the latter structure in a vesicular membrane (TEXT FIG. 3, E). They are ultimately liberated into the outside medium by the bursting of the membrane. These spores are about 3 μ in diameter, uniciliate, and possess a single, refractive oil globule (TEXT FIG. 3, I). After a period of motility the zoöspore comes to rest on an algal filament, absorbs its cilium, and produces a needle-like tube which penetrates the wall of the host. Within, there is at once formed a small, irregular swelling from which rhizoids arise (TEXT FIG. 3, H). The body of the zoöspore increases in size and soon forms the characteristic apical teeth. Subsequent growth involves an enlargement of the intra- and extramatrical parts, and often the extension of the rhizoidal system of the fungus.

From the accounts of Rosen (**23**) and Scherffel (**24**), it is probable that in this *Dentigera* group, there is some variation with respect to the stage in their maturation at which the zoöspores are liberated from the sporangium proper. Both of these investigators, the former observing *P. Zygnematis* (Rosen) Schröter, the latter "*Rhizidium quadricorne* deBary" (from his figures, probably *P. planicorne*), indicate that the zoöspores are fully

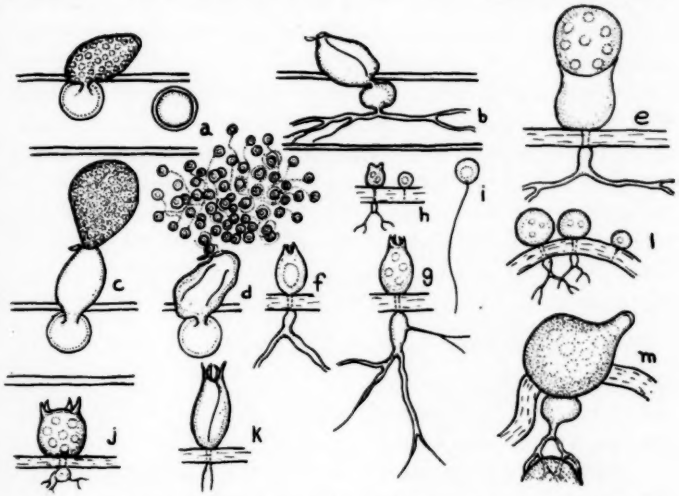

FIG. 3. (a) *Chytridium Schenkii.* Germinated and ungerminated resting spore in *Oedogonium* (× 600). (b) Discharged sporangium of the same fungus (× 600). (c) *C. Schenkii.* Discharge of zoöspores from sporangium formed by germinating resting spore (× 600). (d) Dispersal of zoöspores, same fungus (× 600). (e) *Phlyctochytrium planicorne.* Discharging sporangium in *Rhizoclonium* (× 600). (f, g) Sporangia of same fungus showing variation in subsporangial swelling (× 670). (h) Zoöspore penetration and early stage in sporangial development of same fungus. (i) Zoöspore of *P. planicorne* (× 670). (j) Sporangium of same fungus with spherical apophysis (× 750). (k) Discharged sporangium of same species with fusiform apophysis (× 670). (l) *Rhizidiomyces apophysatus.* Penetration of the zoöspore and early stages in the development of the sporangia (× 670). (m) Nearly mature sporangium of the same fungus in *Achlya* (× 670).

formed before emergence from the sporangium. In the present material, as has been intimated, while cleavage of the zoöspores had been initiated before discharge, these bodies seemed to be finally fashioned in the extruded membrane. All accounts agree,

however, that the zoöspores do not escape singly, as in *Rhizophidium pollinis*, etc., but pass out of the sporangium in a mass, surrounded by a membrane which has been extruded from the sporangium. Only after the deliquescence or rupture of this sac are the zoöspores finally liberated into the water.

No resting spores have been observed in any member of this group.

Parasitic in *Spirogyra* sp. (?) and *Rhizoclonium hieroglyphicum*, Fish Hatchery Pond near Schoolhouse; 1928; Cambridge, Mass., 1927; Ithaca, N. Y. (Atkinson).

The genus *Phlyctochytrium*, as it is now understood, seems wholly unsatisfactory. It includes forms with a *Rhizophidium*-like type of non-sexual reproduction (*P. Hydrodictyii*, etc.), and forms in which zoöspore production approximates that of *Rhizidium*. To the writer's mind, the *Dentigera* of Rosen should be removed from the Rhizophidieae, where they are now listed by Minden (**20**), and placed in the Rhizidieae, near *Saccomyces* and *Rhizidium*.

CHYTRIDIUM SCHENKII (Dangeard) Scherffel, Arch. Protistenk. **54**: 237. 1926.

Rhizidium Schenkii, Dangeard, Ann. Sci. Nat. VII. **4**: 297. 1886.
Rhizidium intestinum Schenk, pro parte, Über das Vorkommen kontraktiler Zellen im Pflanzenreiche. Wurzburg. 1858.
Phlyctochytrium Schenkii (Dang.) Schröter, l.c. p. 78.

The writer's attention was first directed to this fungus by observing the germination of its intramatrical resting spores. These bodies, which were probably first seen in this species by Petersen (**22**), are smooth, thick-walled, about 10 μ in diameter, and possess a highly refractive, oily content (TEXT FIG. 3, A). No rhizoids were seen in connection with these bodies. Germination, which has apparently hitherto been unobserved, was accomplished by the extrusion from the resting spore to the outside of the host cell of an elongate, sac-like body, about 15 μ long by 10 μ in diameter (TEXT FIG. 3, A). This structure, which may be regarded as a sporangium, is filled with finely granular protoplasm in which there are interspersed minute oil droplets. At the apex of the sporangium, there is formed a hyaline oper-

culum, about 3 μ in diameter. Coincident with the production of this cap, the oil droplets within the sporangial protoplasm become organized into many refractive globules of the same size and placed approximately the same distance apart. Cleavage furrows are not apparent now within the sporangium. After a short time, the operculum is thrown back and the protoplasm emerges, only partially cleaved into spores. The discharged protoplasm is surrounded by a flask-shaped membrane of an exceedingly tenuous nature (TEXT FIG. 3, C). Within this, the zoöspores are finally fashioned, although in contrast to such forms as *Lagenidium* and *Pythium*, there is no active movement on the part of the swarmers during this process. After 5–10 minutes the vesicular structure breaks, apparently because of the steady increase in the size of the spores as they mature. The latter are forcibly ejected from their former positions and remain motionless for a brief interval, distributed in a fan-shaped manner (TEXT FIG. 3, D). They then uncoil their cilia, which were not previously observed, and dart away. The zoöspore is spherical, about 2 μ in diameter, with a minute oil droplet and a cilium about 10 μ in length.

In the foregoing account of zoöspore formation, it cannot be said with certainty whether the discharged zoöspores were held in place by a definite membrane or whether they were merely imbedded in a viscid substance. However, the impression one obtained from observing the discharge, maturation, and subsequent dispersal of the spores tended to support the theory that a definite surrounding membrane was present.

Sporangia were also observed, though less frequently than germinating resting spores. The former were of the same size and shape as those produced by the germinating resting spores. Each sporangium possessed a spherical, subsporangial, intramatrical swelling about 8–10 μ in diameter. From the base of the latter body, rhizoids emanated and ramified through one or more cells of the host (TEXT FIG. 3, B). Zoöspores were produced in the same manner as that described for the resting spores. In this process the content of both intra- and extramatrical parts of the sporangium was discharged.

Although Scherffel has placed this form in *Chytridium*, with

which it is more nearly related, the method of zoöspore formation is somewhat different from that encountered in a species such as *C. Olla*. The partial organization of the zoöspores within the sporangium followed by the final cleavage after emergence is *Rhizidium*-like in its features. However, the presence of an operculum and of an intramatrical resting spore distinguishes it as a *Chytridium*. Perhaps in the future, when more material of this and related forms is observed, it will be found advisable to segregate *C. Schenkii* from this genus. Such a course, the writer feels, would further clarify generic concepts in this group.

Parasitic in *Oedogonium* spp., Fish Hatchery, 1928; Waverley, Mass., 1929.

RHIZIDIOMYCES APOPHYSATUS Zopf, Nova Acta Akad. Leop.-Carol. **47**: 188. 1884.

Sporangia extramatrical, ovoid to globose, 12–18 μ in diameter, with a well defined, broad discharge tube; possessing an intramatrical, subsporangial portion, spherical, about 3.5 μ in diameter, but varying with the size of the extramatrical part. From the subsporangial swelling a system of branched rhizoids arises, which penetrates, the eggs of the fungous host (TEXT FIG. 3, M). The undifferentiated sporangial protoplasm is ejected into a vesicle formed at the apex of the discharge tube and is there cleaved into zoöspores. After maturation is completed the latter rupture the vesicle and escape. A few of these spores, which are about 3 μ in diameter, usually retreat into the sporangium and may remain active there a long time. The zoöspore, upon coming to rest on an oögonium of a fungus, in this case, *Achlya*, produces a needle-like penetration tube which pierces the host wall, and, within, enlarges to a knob-shaped body (TEXT FIG. 3, I). From the latter structure, the apophysis, there is produced a rhizoidal system which branches and rebranches within the oögonium, the tips penetrating the eggs of the host. Further growth involves the enlargement of the extra- and intramatrical portions, as well as the elongation and ramification of the rhizoids. As the sporangium matures, a discharge tube is formed, through which the protoplasm of the whole plant is ultimately discharged.

Parasitic in *Achlya* sp. (?), Fish Hatchery, 1929; North Carolina (Coker).

DIPLOPHLYCTIS INTESTINA (Schenk) Schröter, l.c. p. 78.

Rhizidium intestinum Schenk, pro. parte, l.c., *figs. 1–9.* 1858.

This is one of the most common and most striking of all of the chytrids and may usually be found in most dead plants of *Nitella*. The sporangia (TEXT FIG. 2, J), which are intramatrical, consist of a globular portion, varying greatly in size (usually about 25 μ in diameter), and a subsporangial apophysis. The latter is variable in size but is usually about one-half the diameter of the sporangium. From the apophysis there is produced a richly branched system of rhizoids which may ramify extensively throughout the host cell. The sporangium discharges its fully formed zoöspores to the outside of the host cell by means of a tube of variable length.

Resting spores are abundantly formed and are similar to the sporangia in their main features (TEXT FIG. 2, E). The wall of the spore is thick, dark brown, and beset with numerous slender spines. These resting spores vary greatly in size, but in the present material are 10–26 μ in diameter. The apophysis varies from 2.7–5.2 μ in diameter.

Details of the morphology and life history of this organism have been recently described by Karling (**15**).

Saprophytic on dead cells of *Nitella flexilis*, Fish Hatchery, 1926–30. *Nitella* and *Chara*, New York (?) (Karling).

HARPOCHYTRIUM HEDENII Wille, Petermann's Mitt. Erg. **131**: 371. 1900.

Rhabdium acutum Dang., Ann. Myc. **1**: 61. 1903.

Fulminaria Hedenii Wille, Nyt. Mag. f. Naturvidenskab. **41**: 175. 1903.

This fungus was first called to the writer's attention by Dr. A. W. Blizzard, who found it on filaments of *Oedogonium*, collected in the vicinity of the Laboratory. Subsequently, the writer found other material, not only on this alga, but on *Spirogyra* as well.

On both algae the sporangia were markedly curved and resembled slender sickles. Those on *Oedogonium* varied from

13–50 μ in length by 2–2.6 μ in diameter (TEXT FIG. 2, H), while on *Spirogyra* they were about 31 μ long by 2 μ in diameter (TEXT FIG. 2, I). The tips of the basal, sterile portions of the sporangia, which partially penetrated the walls of the host, were not expanded, as has been described for other plants of this species, but were blunt and peg-like in appearance. No proliferation of the sporangia was observed.

This genus has been discussed in detail by Atkinson (**1**, **2**) and more recently by Graff (**12**).

On *Oedogonium* and *Spirogyra* spp., Fish Hatchery, 1928; New York (Atkinson); Montana (Graff).

FAM. CLADOCHYTRIACEAE

CATENARIA ANGUILLULAE Sorokin, Ann. Sci. Nat. VI. **4**: 67. 1876.

This interesting member of the Cladochytriaceae was found in the shell of a species of rotifer (*Monostyla* ?). Whether or not it was parasitic could not be determined. The sporangia were irregularly ovoid, flask-shaped structures, connected to one another by a septate mycelium about 2 μ in diameter (TEXT FIG. 4, H). Extremely delicate rhizoids were apparent emanating from this mycelium, as well as from the sporangia. The latter structures were from 15.6–26.3 μ in length by 13–15.6 μ in diameter. The zoöspores were formed within the sporangium and were discharged successively through a tube, 2.7 μ in diameter and of variable length, to the outside of the body of the host. They were spherical, 2 μ in diameter, with a single cilium and one or often two oil globules. With respect to size, these spores agree more nearly with those of Sorokin's fungus (1.5–2 μ) than with those reported by Butler (**5**) (6.5–7.5 μ $\times$4–4.5 μ).

This seems to be the first record of this fungus occurring on a mature rotifer. Butler's recent paper (l.c.) gives a good account of the fungus as it occurs on rotifer eggs, and also summarizes the literature.

Parasitic (?) in mature rotifer, Second Lake, 1928.

CLADOCHYTRIUM NOWAKOWSKII Sparrow, Am. Jour. Bot. **18**: 615, 1931.

This species (TEXT FIG. 4, F) has been described by the writer in a previous paper (l.c.). It closely resembles *C. replicatum* Karling (Am. Jour. Bot. **18**: 526. 1931) to which it ultimately may be referable. Both species resemble *C. polystomum* Zopf (l.c. PL. 21, FIGS. 1–11, explanation p. 234, no description in text). However, since Zopf observed no asexual reproduction it is impossible to tell what he had and his species should be disregarded.

Parasitic in *Spirogyra* sp.(?), *Oedogonium* spp.(?) and *Coleochaete* sp.(?), Fisch Hatchery, 1928; Hanover, N. H., 1931.

Physocladia Sparrow, gen. nov.

Mycelium extensive, branched; variable in character; possessing septate turbinate cells, as well as large, non-septate, fusiform to irregular swellings. Sporangia with apophyses; proliferating. Zoöspores uniciliate; completely formed within the sporangium; liberated through a pore after the deliquescence of a papilla, into a well defined vesicle, where they swarm for a period before rupturing this structure and escaping; upon germination, giving rise to an extensive mycelium bearing the sporangia and resting spores.

Mycelio copioso, ramoso, irregulari, extramatricali. Sporangio apophysibus munito, proliferante, papilla (non operculo) munito. Zoösporis 1-ciliatis, exeuntibus in vesicam. Sporis perdurantibus crassiuscule tunicatis, extramatricalis.

The specific description of *N. obscura* has been given in a former paper (**28**).

Physocladia obscura Sparrow, comb. nov. (TEXT FIG. 4, E).

?Nowakowskiella obscura Sparrow, Am. Jour. Bot. **18**: 619. 1931.

A detailed description of this fungus has been given in a recent paper by the writer (**28**). Because of the obvious similarity in habit and in the resting spores to *Nowakowskiella*, the fungus was tentatively assigned to that genus. However, since the aforementioned paper was written, the writer has had an opportunity to examine an abundance of material of *Nowakowskiella elegans*, collected at Hanover, N. H., and has been able to compare the non-sexual reproduction of the two organisms. It was at

first supposed that the method of non-sexual reproduction of *Nowakowskiella* would be sufficiently variable to include the Cold Spring Harbor fungus in this genus. However, after critically examining zoöspore production in *Nowakowskiella* under varying conditions, it has been found that this process is remarkably stable in its main features. An operculum is always thrown off, enabling the zoöspores to slip out of the sporangium,

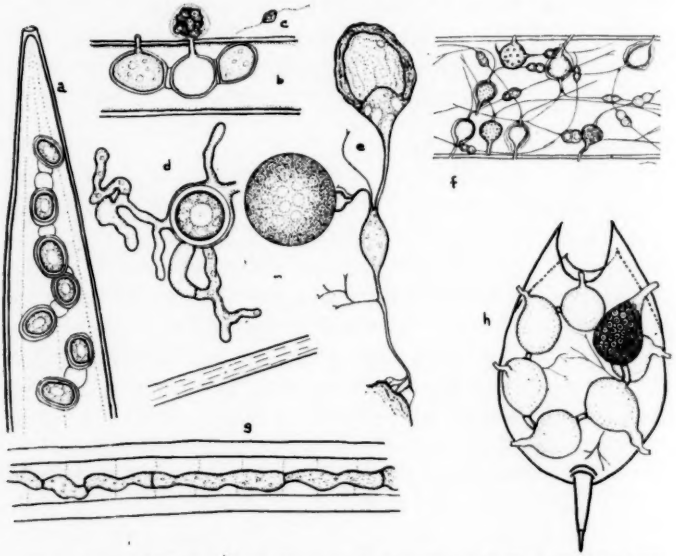

FIG. 4. (a) *Myzocytium proliferum*. Resting spores in *Closterium* (× 200). (b) Sporangia and zoöspore formation of same fungus in *Mougeotia* (× 365). (c) Zoöspore of same fungus (× 365). (d) *Lagenidium Rabenhorstii*. Mature oöspore, antheridium and portion of thallus in *Spirogyra* (× 670). (e) *Physocladia obscura*. Habit of plant on pollen grain, showing immature and proliferated sporangia (× 360). (f) *Cladochytrium Nowakowskii*. Portion of a cell of *Spirogyra* infected by the fungus (× 175). (g) *Resticularia nodosa*. Portion of thallus in *Tolypothrix* (× 760). (h) *Catenaria Anguillulae*. Sporangia in *Rotifer* (× 370).

surrounded or imbedded in "slime." At the mouth of the sporangium they remain motionless for a time, ultimately bursting apart and swimming away. No instances of zoöspores swimming actively out of the sporangium into a rigid, flask-

shaped vesicle after the deliquescence of a papilla were observed. This, it will be recalled, was the typical method of zoöspore discharge in the form termed *P. obscura*. In this respect, the latter fungus resembles to a degree *Physoderma maculare*, as described by Clinton (**6**). However, the method of development, resting spores, and general habit of the organism under discussion differ markedly from *Physoderma*, and the latter need not be considered in this connection.

The characters in which the present fungus differs from *Cladochytrium* and *Nowakowskiella*, as well as those in which it is similar, are summarized in the following table.

TABLE 1

COMPARISON OF *Cladochytrium*, *Nowakowskiella* AND *Physocladia*

Cladochytrium	*Nowakowskiella*	*Physocladia*
1. Zoöspores emitted by gelatinization of apex of a discharge tube, which is always formed	1. Zoöspores emitted after dehiscence of an operculum. Discharge tube not usually formed	1. Zoöspores emitted by gelatinization of a papilla. No discharge tube
2. Zoöspores a motionless mass at the mouth of the tube, surrounded by a slime coat	2. Zoöspores a motionless mass, surrounded by slime, at mouth of sporangium	2. Zoöspores an actively swarming mass, confined in a definite vesicle
3. Zoöspores liberated by the swelling of the spores, which bursts slime coat	3. Zoöspores liberated as in *Cladochytrium*	3. Zoöspores liberated by rupture of vesicle wall by one or more swarmers
4. Resting spores not known	4. Resting spores borne on the extramatrical mycelium; spherical, thick-walled	4. Resting spores as in *Nowakowskiella*
5. Habit of plant usually intramatrical; tenuous, saprophytic or parasitic	5. Habit of plant extramatrical, larger than *Cladochytrium*. Saprophyte	5. Habit of plant as in *Nowakowskiella*. Saprophyte

Although the Cold Spring Harbor organism [2] possesses close affinities with *Nowakowskiella* and *Cladochytrium*, in the light of our present knowledge, and if a sharp delimitation of genera is to be maintained, it seems more desirable to segregate the fungus in a new genus, than to attempt to include it in any previously described one. The foregoing generic diagnosis is therefore included.

[2] In its habit rough-walled resting spore and vesicle this fungus is quite similar to the problematical *Zygochytrium aurantiacum* Sorokin (**25**).

ANCYLISTALES

FAM. ANCYLISTACEAE

MYZOCYTIUM PROLIFERUM Schenk, l.c. p. 10. 1858.

Pythium proliferum Schenk, Verh. Phys.-Med. Ges. Würzb. **9**: 20. 1857 (Not *Pythium proliferum* deBary).

Pythium globosum Walz, Bot. Zeit. **1870**: 554, pro parte.

Pythium globosum Schenk, Verh. Phys.-Med. etc., p. 25. 1857.

Lagenidium globosum Lindstedt, Synopsis d. Saprolegnieen, p. 54. 1872.

The link-like mycelium of this fungus has been found a number of times on various members of the Conjugatae, and the species is apparently a common one. The mature, unbranched thallus, which consisted of 1–6 spherical to ellipsoidal links, about 15.7 μ long by 13 μ in diameter, possessed a finely granular content in which were imbedded the characteristic, highly refractive granules similar to those found in other members of the order.

Discharge of the zoöspores was observed in many instances. From each link of the thallus, now invested with a definite wall which separated it from the adjoining portion, there was developed a tube, about 2 μ in diameter, which pierced the host wall (TEXT FIG. 4, B) and through which the protoplasm of the fungus was discharged to the outside. There, surrounded by an exceedingly tenuous vesicle, maturation of the zoöspores took place in a manner entirely similar to that of *Pythium*. The zoöspores were of the typical laterally biciliate type (TEXT FIG. 4, C), 5.4 μ in length by 3.6 μ in width.

Sexual reproduction was observed in only a few instances. This involved the discharge of the protoplasm of one, more narrow cell through a short, laterally placed tube into an adjoining, more spherical cell. In the latter, there was subsequently formed a spherical, thick-walled "oöspore," 10–25 μ in diameter, which never completely filled the "oögonium." Ellipsoid, more angular spores, 18–27 μ in diameter, were found in *Closterium acerosum* (TEXT FIG. 4, A).

Parasitic in *Mougeotia* sp. (?) and *Closterium acerosum*, Second Lake, 1928–30; Hanover, N. H., 1930–31; Iowa (Martin); Montana (Graff).

LAGENIDIUM RABENHORSTII Zopf, Sitz.-ber. Bot. Ver. Brand. **20**: 77. 1878.

This fungus has been observed a number of times on various species of *Spirogyra*. The sparingly branched thallus of limited extent, which consisted of hyphae 2.6–5 μ in diameter, was slightly constricted wherever the irregularly placed cross walls occurred.

Zoöspore formation took place in the same manner as that described for *Myzocytium*. The protoplasm of a hyphal segment was discharged through a tube to the outside of the host and there, within a vesicle, was cleaved into zoöspores. The latter were similar to those of *Myzocytium*. The sex organs were more highly developed than those of the last named genus and closely resembled types found in *Pythium*. The antheridium was of a crooknecked type, 15 μ long by 5 μ in diameter, and was separated from the rest of the hypha by a cross wall. The oögonium, which occurred on the same hypha as the antheridium, was spherical, and about 15 μ in diameter. After fertilization, during which there was a passage of antheridial protoplasm through a tube into the oögonium, there was formed a thick-walled oöspore, about 10.4–13 μ in diameter (TEXT FIG. 4, D).

Parasitic in *Spirogyra* spp., Fish Hatchery, 1928–30; Cambridge, Mass., 1928; New York (Atkinson); Montana (Graff).

(?)RESTICULARIA NODOSA Dangeard, Le Botaniste **2**: 96. 1890–91.

The irregular thallus of what is possibly this fungus was found on *Tolypothrix* (TEXT FIG. 4, G). The mycelium was unbranched and constricted at irregular intervals. Occasional cross walls were present, but were not found in all instances where the hyphal constrictions occurred (TEXT FIG. 4, G). No reproductive organs were observed and hence the writer can add nothing to our scanty knowledge of this form. From the shape of the thallus and its habitat, however, there is a strong possibility that this is the mycelium of *Resticularia*.

Parasitic in *Tolypothrix* sp. (?), Fish Hatchery, 1928; Cambridge, Mass., 1927.

MONOBLEPHARIDALES

MONOBLEPHARIDACEAE

MONOBLEPHARIS SPHAERICA Cornu, Ann. Sci. Nat. V. **15**: 82. 1872.

The mycelium of this fungus, which is 3–8 μ in diameter, is characterized, as are all other members of the order, by a peculiar, reticulate, or foamy disposition of the protoplasm (PLATE 7, F).

In its sexual apparatus, this species is readily distinguished from other members of the genus. The antheridia, which are 10–20 μ long by 5 μ in diameter, are always formed just beneath the oögonium (PLATE 1, F). In the antheridium there is formed a varying number of uniciliate sperm, which upon maturity creep out of the former structure in an amoeboid fashion. Ultimately, one of these may come to rest on the apical receptive papilla of the oögonium. The sperm immediately sinks into the egg cell and is soon completely absorbed. After a few minutes, the fertilized egg emerges from the oögonium and there it ultimately becomes invested with a thick, brown, bullate wall. These oöspores vary from 15–20 μ in diameter. A type of endogenous "chlamydospore" similar to those figured by Woronin (**29**) for this species was observed in numerous instances.

Further details of this and other species of *Monoblepharis* are reserved for a future paper on this whole group, which the writer has in preparation.

Saprophytic on twigs of *Betula*, spring, near Second Lake, 1929; Waverley, Mass., 1928–29; Hanover, N. H., 1930; Mt. Holly, Pa., 1931.

GONOPODYA POLYMORPHA Thaxter, Bot. Gaz. **20**: 481. 1895.

The filamentous, sparingly branched thallus of this species is usually constricted at irregular intervals where hyaline, pseudoseptae occur (PLATE 7, L). The hyphae, which are 2.5–5.2 μ in diameter, exhibit a foamy, sometimes reticulate protoplasmic structure, similar to that found in *Monoblepharis*. Near the ends of the branches the tufted hyphal segments become more spherical, and on these, ovate sporangia are formed. The latter vary from 18–52 μ in length, by 18–36 μ in diameter. A

variable number of somewhat cylindrical zoöspores, 10 μ long by 5–8 μ in diameter, are formed in each sporangium. At maturity, these emerge in an amoeboid manner from the apex of the sporangium. The zoöspores are uniciliate, and seem to have the same internal structure as the zoöspores and sperm of *Monoblepharis*. After discharge of the zoöspores the sporangia may often proliferate.

Saprophytic on twigs of various types, and on apples, Fish Hatchery, *Sphagnum* bog, Second Lake, 1927–28; Belmont, Mass., Cambridge, Mass., 1927–29; Hanover, N. H., 1930; Cambridge, Mass., Maine (Thaxter).

GONOPODYA SILIQUAEFORMIS (Reinsch) Thaxter, l.c. p. 480.

Saprolegnia siliquaeformis, Reinsch, Jahrb. Wiss. Bot. **11**: 293. 1876.

Gonopodya prolifera Fischer, l.c. p. 382. 1892.

The distinguishing feature of *G. siliquaeformis* is its long, tapering, pod-like sporangia (PLATE 7, A), and the profusely branched mycelium. The sporangia vary greatly in their dimensions, in the Cold Spring Harbor material being 52–59 μ long by 20–23 μ at greatest diameter. These measurements are considerably smaller than those given by Thaxter and Kanouse (**14**) (130–250 $\mu \times$ 22–30 μ). However, in material collected at Cambridge, Mass., which cannot otherwise be distinguished from the present material, the dimensions easily approximated those given by the aforementioned investigators. In fact, in a single pustule one may sometimes find sporangia of all sizes, and varying in shape from a polymorpha to a siliquaeformis type. This species, in contrast to *G. polymorpha*, is usually found under foul conditions of environment. When so growing, the walls of the sporangia often are colored a yellow-brown.

Saprophytic on twigs and apples, Fish Hatchery, 1928–29; Cambridge, Mass., 1928–30; Mt. Holly, Pa., 1931; Maine, Mass. (Thaxter); Michigan (Kanouse).

BLASTOCLADIALES

BLASTOCLADIACEAE

BLASTOCLADIA PRINGSHEIMII Reinsch, Jahbr. Wiss. Bot. **11**: 298. 1878. Amend. Thaxter, Bot. Gaz. **21**: 51. 1896.

Plant body consisting of a large basal cell, which varies greatly in size, in the present material attaining a length of 130 μ, and a diameter varying from 10–26 μ in the cylindrical to tapering, basal, trunk-like portion, to 25–52 μ in the expanded, distal part (PLATE 7, H). On the latter region of the thallus are placed the cylindrical sporangia. These are quite variable in size, although the smaller sporangia are usually found on the smaller plants. In the Cold Spring Harbor material the sporangia are 53–62 μ in length by 7.8–18 μ in diameter. Long setae are frequently present on the plants, although they are not always found. The lower portion of the basal cell terminates in a series of branched, root-like rhizoids, which penetrate the substratum. The content of the basal cell is often characterized by the presence of large, irregularly shaped refractive oil globules which lend a distinctive appearance to the plant.

Zoöspores are completely formed within the sporangium and escape, according to Thaxter (l.c.) and Kanouse (**14**), singly, without the formation of a vesicle. However, in material of this species obtained at Hanover, N. H., a type of zoöspore discharge similar to that described by Minden in 1916 (**21**, p. 193) was observed. During cleavage of the spores within the sporangium, a sharply defined apical cap (PLATE 7, C) was formed, from the under side of which a peg-like structure protruded. Upon the emergence of the zoöspores, the peg disappeared, and the cap was carried up with the mass of spores (PLATE 7, D). The latter were surrounded by a definite membrane which held the spores in a cylindrical column. When the column of spores nearly equaled the sporangium in length, the membrane broke, the cap disappeared from view and the spores continued on through the mass of scum and bacteria surrounding them, maintaining clumps of four or eight, yet tending to separate and swim away by their own motility (PLATE 7, E). Save for the greater length of the spore column, this account is essentially the same as that described by Minden for this species. In material that has recently been collected of this species, a similar mode of discharge was observed, save that the vesicle was ruptured somewhat earlier. It is probable that the formation and subsequent extent of development of the vesicle is dependent, in this form,

on how favorable conditions are for zoöspore discharge. Under "optimum" conditions of temperature, as defined by Cotner (**8**) for this species, the aforementioned type of zoöspore discharge has always been observed to take place.

No resting spores were found in the Cold Spring Harbor material, but these have been observed in abundance in recently collected material. Whether or not in the first instance we were dealing with gamete-bearing plants or ones wholly non-sexual, as might be anticipated from Kniep's work on *Allomyces* a closely related genus (**17**), was not determined.

On apple, Fish Hatchery, 1927; Belmont, Mass., 1928; Hanover, N. H., 1931; Cambridge, Mass., Maine (Thaxter); Michigan (Kanouse).

BLASTOCLADIA RAMOSA Thaxter, l.c. p. 50.

Specimens of *B. ramosa* were found in the same pustules as the preceding species (PLATE 8, J). Discharged sporangia, 30 μ long by 12 μ in diameter, and thin-walled, spatulate, resting spores, 25 μ long by 10–12 μ in diameter, were found. The whole plant was characterized by an open, ramose habit, and narrowly cylindrical basal cell.

Maine (Thaxter); Montana (Graff).

Blastocladia truncata Sparrow, sp. nov.

Basal cell narrowly cylindrical, unbranched, slightly expanded at the top; 250–286 μ in length by 7.7–26 μ in diameter; possessing a slightly branched rhizoidal system. Sporangia truncate, nearly as broad as long, 10.4–15 μ long by 10.4–12 μ in diameter. Plant without setae. Zoöspores 3.5 μ in diameter. Resting spores not observed.

Cellula basali anguste cylindracea, irramosa, paulum ad apicem dilatata, sine setis; 250–286 μ long., 7.7–26 μ dia.; rhizoidibus paulo ramosis. Sporangiis truncatis, 10.4–15 μ long., 10.4–12 μ dia. Zoösporis 3.5 μ dia. Sporis perdurantibus non perspectis.

Hab. in fructibus mali in aqua.

This plant has been observed in several instances and does not seem to be simply a form of *B. Pringsheimii*. It is distinct from other described species by the shape of the sporangia. Before discharge, these are distinctly truncated at both apex and base,

but after ejection of the zoöspores, appear more tapering (PLATE 7, G).

Saprophytic on apple, Fish Hatchery, 1927.

LEPTOMITALES

LEPTOMITACEAE

SAPROMYCES REINSCHII (Schröter) Fritsch, Oesterr. Bot. Zeits. **43**: 420. 1893.

Hyphomycetarum Reinsch, Contr. Algol. & Fungol. **1**: 1875.
Naegelia Reinsch, Jahrb. Wiss. Bot. **11**: 298. 1878.
Naegeliella Reinschii Schröter, l.c. p. 103.
Sapromyces dubius Fritsch, l.c.
Rhipidium elongatum Cornu, Ann. Sci. Nat. V. **15**; 15. 1872.

From a narrow basal cell attached by rhizoids to the substratum, the long secondary axes of the fungus arise. These, by further branching, form a thallus which in some instances may attain a length of over 1000 μ (PLATE 7, J). The segments of the body are delimited by constrictions with pseudo-septa. At the junctures of the segments, whorls of narrowly cylindrical sporangia, about 50 μ long by 10–15 μ in diameter, arise.

The sex organs of this species are characterized by the fact that the male and female organs are found on different plants. Preliminary experiments by P. H. Jordan, soon to be published, seem to indicate that this species is heterothallic. Spherical to pyriform oögonia arise from short, constricted branches formed in the same position on the axis as the sporangia. The antheridia are irregular, expanded bodies formed at the termini of long, twisted hyphae. They are usually found attached to the upper part of the oögonium (PLATE 1, K).

The oöspore is spherical, about 20 μ in diameter, with a slightly irregular, thick, dark wall. The content of this spore usually possesses a single oil globule. During maturation of the oöspore, the outer wall of the oögonium becomes a dark brown color, and is usually somewhat roughened by this "incrustation."

Saprophytic on twigs of various sorts, spring near Third Lake, 1928; Cape Ann, Mass., 1926; Arlington, Mass., 1928; Maine (Thaxter); ?North Carolina (Couch), a sterile form; Montana (Graff).

SAPROMYCES ANDROGYNUS Thaxter, Bot. Gaz. **21**: 329. 1896.

The general habit of the plant, although not so extensive, is similar to the preceding species (PLATE 7, B). Sporangia are borne in the same manner and are about the same size as those of *S. Reinschii*. The sex organs of the two are different with respect to the origin of the antheridia. In contrast to *S. Reinschii*, the antheridium of this species is androgynous in origin, and arises from a short hyphal outgrowth just below the oögonial stalk (PLATE 7, I). The distal portion of the male organ is usually attached to the top of the oögonium. Occasionally, twists in the antheridial filaments, similar to those figured by Thaxter, were observed. The oögonia were usually about 30 μ in diameter and the mature oöspores, similar in appearance to those of *S. Reinschii*, were about 15–20 μ in diameter. The darkening of the oögonium wall, noticeable in the last mentioned species, was not observed in this material of *S. androgynus*, although Thaxter described it as occurring in his material.

Saprophytic on *Fraxinus* twigs, First Lake, 1929; Arlington, Mass., 1928; vicinity of Cambridge, Mass. (Thaxter).

APODACHLYA PYRIFERA Zopf, Nova Acta Acad. Leop-Carol. **52**: 362. 1888.

Leptomitus pyriferus Zopf, Die Pilze, Schenk's Handbuch **4**: 299. 1890.

A common inhabitant of twigs in cold water. The sparingly branched hyphae are constricted at intervals of 130–185 μ, and possess a finely granular, somewhat hyaline content in which are occasional refractive granules ("cellulin"). Pyriform to spherical sporangia, about 44 μ long by 14–22 μ in diameter, are borne either terminally or laterally on the hyphae. The spores are cleaved out within the sporangium, and, after being discharged successively from the latter body, form a motionless, irregular mass at the mouth of the apical, sporangial pore. These cysts, 4–8 in number, measure about 11 μ in diameter. After a varying length of time, there emerges from each cyst a motile zoöspore of the "secondary," biciliate type. No resting spores were observed in the present material.

Saprophytic on twigs of *Fraxinus*, First Lake, 1927; Arlington, Mass., 1928.

APODACHLYA BRACHYNEMA (Hildebr.) Pringsheim, Ber. Deuts. Bot. Ges. **1**: 289. 1883.

Leptomitus brachynema Hildebrand, Jahrb. Wiss. Bot. **6**: 261. 1867.

Apodya brachynema (Hildebr.) Cornu, Ann. Sci. Nat. V. **15**: 14. 1872.

This seems an even more common plant than the preceding one, and is often found on decaying apples in water. The thallus is characterized by the production of moniliform cells, varying from 11.2–29.6 μ in diameter, sometimes spherical, or more often, 2–3 times as long as wide. The spherical resting spores are borne terminally and vary from 25–33 μ in diameter. They possess a definite wall, about 1.5–2 μ in thickness, which is distinct from the "oögonial" wall. Passage of protoplasm from the moniliform cell immediately below the "oögonium" has been observed a number of times. No sporangia were found, but the moniliform cells and the lack of punctations on the resting spore serve to distinguish it from the previously described species and *A. punctata* Minden.

Saprophytic on apples and twigs, Fish Hatchery, 1928–29; Arlington, Mass., 1928; North Carolina (Coker); Massachusetts (Thaxter); Michigan (Kanouse); Mississippi, Wisconsin (Harvey).

ARAIOSPORA PULCHRA Thaxter, Bot. Gaz. **21**: 328. 1896.

This exquisite plant was found only once at Cold Spring Harbor, but was collected in abundance in Massachusetts. The stout basal cell with its rhizoids is about 50–80 μ in diameter, and may attain a length of 800–1000 μ (PLATE 8, F). Its cylindrical, apical region is much branched, and on these hyphae the reproductive organs are borne.

In this genus, sporangia of two kinds are formed. One type is similar to that found in *Sapromyces*, while the other may be more spherical and furnished with spines. In the present species, according to Thaxter, the spines are usually stout, radiating in all directions, and generally disposed over the whole sporangium. In *A. coronata* Linder (**18**), they form an apical crown of short incurved prongs around the papilla of discharge. Sporangia of the spiney type were not seen in the Cold Spring

Harbor material, nor were they found in the Massachusetts collection. In both instances, only the cylindrical, smooth-walled ones were observed.

The sexual reproduction of this species, especially the structure and development of the oöspore, is of unusual interest. As it has been described in detail by Thaxter (l.c.) and King (**16**), there is no need to include it here. The pedicellate oöspores, which at maturity are 30–50 μ in diameter, possess not only the usual thickened wall found in other members of this group, but, in addition, a peripheral layer of hexagonal cells which King (l.c.) has shown arises from the periplasm. The whole oöspore completely fills the oögonium (PLATE 8, G). The tortuous antheridial branches generally arise from the same stalk as the oögonium, and the distal, expanded portion, which is cut off from the rest of the hypha, is ordinarily applied near the base of the oögonium.

Saprophytic on twigs of *Fraxinus*, First Lake, 1929; Arlington, Mass., 1928; Cambridge, Mass., 1928; Massachusetts, Maine (Thaxter); Mass. (King).

RHIPIDIUM AMERICANUM Thaxter, l.c. p. 327.

In its main features, the thallus of *Rhipidium* resembles that of *Blastocladia*. The distal portion may, however, be more elaborate and gnarled than is found in the latter fungus. Often the cylindrical, trunk-like portion is not developed, and the rhizoids arise directly from the expanded upper portion. In either case, from the latter region sporangia arise, either terminally on short, constricted pedicels, or sympodially on longer filaments (PLATE 8, A). These sporangia, which vary greatly in size, are ovoid to sub-cylindrical in shape. Details of zoöspore production are described by Thaxter (l.c.).

The sex organs are usually terminally placed on the filaments. The spherical oögonium varies from 33.6–42 μ in diameter, and, after fertilization by the androgynous antheridium (PLATE 8, B), there is produced within it an oöspore, the golden exospore of which is elevated in a series of irregular ridges (PLATE 8, B). This oöspore never fills the oögonium, and varies from 28.4–33.6 μ in diameter.

Variations in the shape and size of the thallus of this plant are

quite remarkable. The peltate specimens described above may be 80–100 μ in breadth, while the cylindrical axis of the tree-like forms may attain a length of 300–900 μ before expanding. The rhizoidal system is also variable in its extent; it is much more developed than that of *Blastocladia*, and may often possess numerous spherical swellings along its many branches.

Saprophytic on Apple, Fish Hatchery, 1927–29; Belmont, Mass., 1928; Cambridge, Mass., 1928; Maine, Mass. (Thaxter); Michigan (Kanouse).

SAPROLEGNIALES

SAPROLEGNIACEAE

APHANOMYCES PARASITICUS Coker, The Saprolegniaceae, with notes on other water molds, 201 pp., 63 pls., p. 165. 1923.

The broad hyphae and dark, spiny oögonia of this species have been found in two instances, both times parasitic in filaments of *Achlya* spp.(?). The hyphae are 5–7 μ in diameter, and, in badly parasitized filaments of the host, may almost completely fill the latter structures (PLATE 8, C). The relationship of the sex organs to each other could not be determined with certainty in the cases observed, due to the crowded conditions within the *Achlya* filaments. Coker states that the large antheridia are diclinous in origin. At maturity, the oöspore lies within an oögonium which possesses a dark wall beset with sharp, gradually attenuated spines, 5–8 μ in length. No sporangia were observed, but from the close agreement of this plant in all other respects with Coker's species, we have no hesitancy in so naming it.

Parasitic in filaments of *Achlya* spp.(?), Jarvis Pool, 1929; Arlington, Mass., 1928; North Carolina (Coker, Couch, Raper).

APHANOMYCES PHYCOPHILUS deBary, Jahrb. Wiss. Bot. **2**: 179. 1860.

An account of this fungus has been given in a previous paper by the writer (**27**).

Parasitic in *Nitella flexilis*, Fish Hatchery, 1929; Maine (Thaxter); Indiana (Weatherwax); Michigan (Kauffman); North Carolina (Couch).

PYTHIALES

PYTHIACEAE

ZOÖPHAGUS INSIDIANS Sommerstorff, Oestrr. Bot. Zeits. **61**: 361. 1911.

This fungus (PLATE 2, H) has been recently described by the writer (**26**). No further points of interest were exhibited by the present material.

Parasitic in various members of the *Rotiferae*, Fish Hatchery, 1930; Maine, 1928; Mass. (Weston).

PYTHIOGETON RAMOSUM Minden, Falck, Mykolog. Untersuch. Berichte **1**: 238. 1916.

The narrow, pyriform sporangia of this fungus (PLATE 8, I) were found in abundance in twig cultures maintained at room temperature. The tenuous hyphae, about 3 μ in diameter, which formed a tangled mass about the twigs, were less frequently branched than those figured by Minden. The sporangia, while varying somewhat in size and becoming successively smaller as proliferation occurred, were generally about 60 μ in length and tapered from 20 to 8 μ in diameter. The sporangial axis of this species runs at nearly right angles to that of the attendant hypha.

Minden considers this species very close to, if not identical with, *P. transversum* Minden. However, the more narrowly pyriform sporangia, with their attenuated beak and terminal position on the hyphae, would seem to mark *P. ramosum* off from the aforementioned species.

No sexual organs were observed either by Minden or the writer.

Saprophytic on twigs of various kinds, First Lake, Jarvis Pool, 1929; Cambridge, Mass., 1927; Sarnia, Ontario, 1928.

PYTHIUM UNDULATUM Petersen, Ann. Myc. **8**: 531. 1910.

Pythiomorpha undulata (Pet.) Apinis, Acta Horti Bot. Univ. Latviensis **4**: 234. 1930.

The sparingly branched, extensive mycelium is characterized by frequent undulations of the hyphae which compose it (PLATE 8, D, E). The latter are somewhat variable in diameter, but usually measure about 5–7.4 μ. The sporangia are narrowly ovoid, but under foul environmental conditions may assume

various shapes. These bodies are at first terminal, but after the discharge of the undifferentiated content through a narrow beak of varying length into a vesicle where the zoöspores are formed, further hyphal growth usually takes place. This may be either by proliferation (PLATE 8, D) through the old sporangium, or, as is usual under excellent environmental conditions, by sympodial branching (PLATE 8, E). The sporangia vary greatly in size, but usually are 40–45 μ long by 12–15 μ in diameter.

On oatmeal agar numerous dark brown, rough-walled chlamydospores, 10–50 μ in diameter, are formed. Similar bodies have been observed in this species by Dissman (**11**).

Apinis has placed this fungus in *Pythiomorpha*, and is impressed with its similarity to *Gonopodya*. Aside from a slight superficial resemblance, there is no character either in the mycelium, sporangium, formation or structure of the zoöspores which could relate it to *Gonopodya*. As a genus, *Pythiomorpha* has certain features in its sexual apparatus which mark it off from *Pythium*. As the fungus under discussion apparently does not possess sex organs, and as its non-sexual reproduction is that of a typical *Pythium*, in the broader sense of that generic term, there seems little justification for changing the original binomial.

This fungus was first reported from the United States in 1927, by the writer (Annual Report, The Long Island Biological Association, 1927). It has also recently been described by Matthews (**19**) from North Carolina. The chlamydospores figured by the last named investigator appear to have smooth, hyaline walls rather than rough, brown ones, as found by Dissmann and the writer.

SUMMARY

In this paper forty species of aquatic Phycomycetes are described from the vicinity of Cold Spring Harbor, Long Island, New York.

Of these fungi, fifteen appear to be reported for the first time in this country, five have apparently not been mentioned in the American literature for twenty years or more, and four are seemingly new to science.

In conclusion, the writer wishes to thank the Long Island

Biological Association for the use of the facilities of that institution, Prof. H. M. Fitzpatrick for certain suggestions made by him, and particularly Prof. W. H. Weston, Jr., for his critical reading of the manuscript.

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EXPLANATION OF PLATES

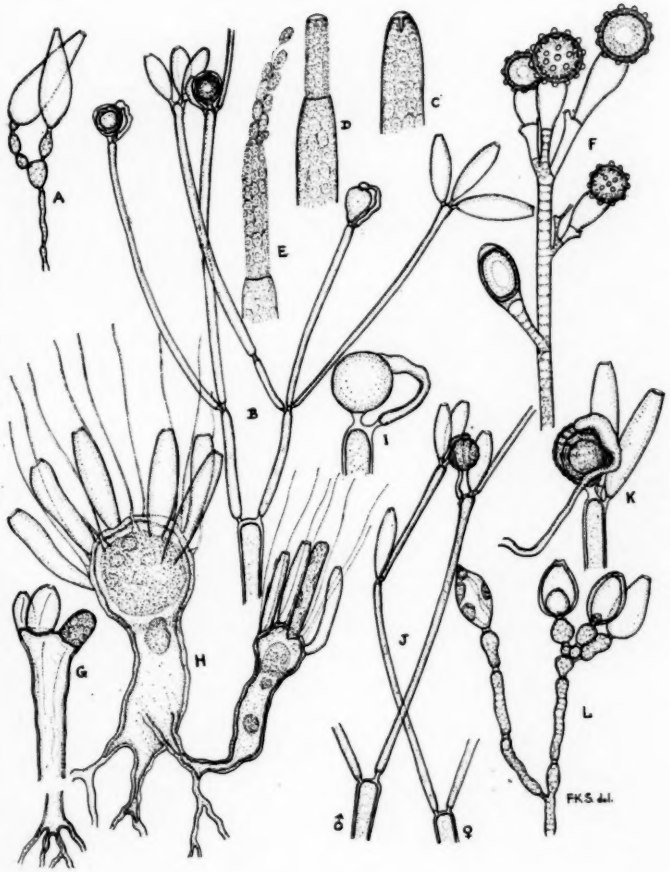
All figures were drawn with the aid of the camera-lucida; the approximate magnifications are given in each instance.

PLATE 7

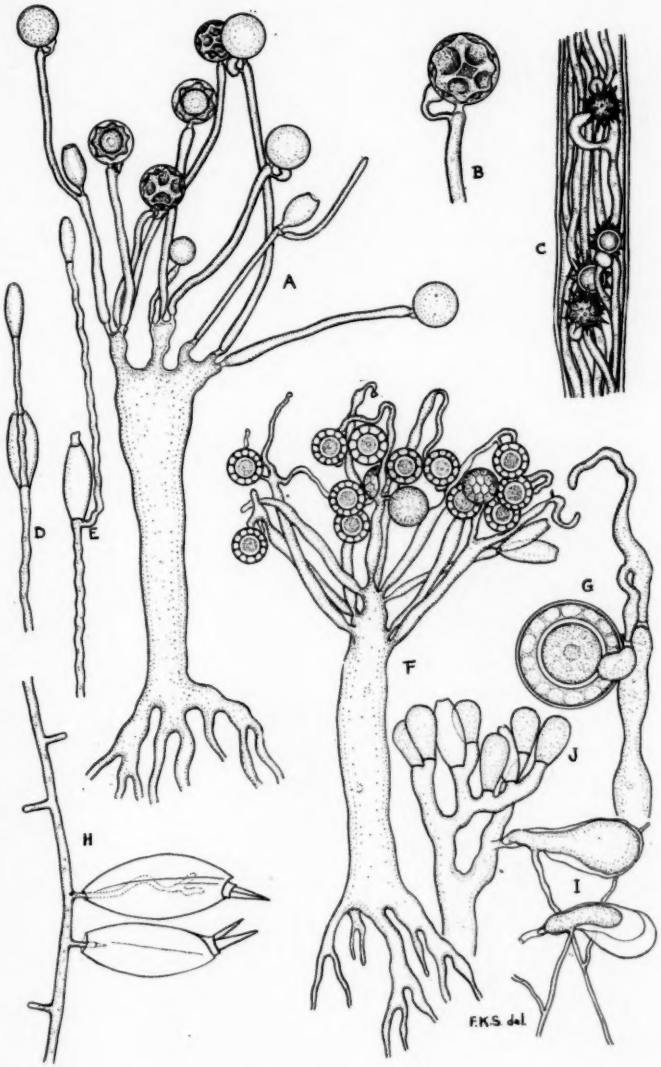
FIG. A. *Gonopodya siliquaeformis*. Portion of a plant with two discharged sporangia. × 250; Fig. B. *Sapromyces androgynus*. Habit of plant showing basal cell and reproductive organs. × 125; Figs. C, D, E. *Blastocladia Pringsheimii*. Stages in the discharge of the zoöspores. × 270; Fig. F. *Monoblepharis sphaerica*. Sexual organs and an endogenous chlamydospore. × 270; Fig. G. *Blastocladia truncata* n. sp. Plant showing discharged and undischarged truncate sporangia. × 270; Fig. H. *Blastocladia Pringsheimii*. Two plants showing variations in size. × 250; Fig. I. *Sapromyces androgynus*. Detail of relationship of young sex organs. × 250; Fig. J. *Sapromyces Reinschii*. Two plants, one bearing an oögonium, the other, an antheridium. Discharged sporangia also present. × 125; Fig. K. *S. Reinschii*. Detail of relationship of sex organs. × 250; Fig. L. *Gonopodya polymorpha*. Portion of a plant showing proliferated sporangia and zoöspores. × 250.

PLATE 8

Fig. A. *Rhipidium americanum*. Plant showing discharged sporangia and sex organs. × 125; Fig. B. *R. americanum*. Detail of sexual apparatus showing mature oöspore. × 250; Fig. C. *Aphanomyces parasiticus*. Portion of plant showing mycelium and sex organs in *Achlya* filament. × 250; Figs. D, E. *Pythium undulatum*. D, showing proliferation of sporangia; E,



AQUATIC FUNGI



AQUATIC FUNGI

showing sympodial branching. × 250; Fig. F. *Araiospora pulchra*. Habit of plant showing oöspores and smooth sporangia. × 75; Fig. G. *Araiospora pulchra*. Detail of nearly mature oöspore and antheridium in combined views (optical-surface). × 250; Fig. H. *Zoöphagus insidians*. Portion of mycelium showing short, peg-like branches and two rotifers which have been captured by the fungus. × 250; Fig. I. *Pythiogeton ramosum*. Portion of mycelium and two proliferated sporangia. × 250; Fig. J. *Blastocladia ramosa*. Plant bearing thin-walled, spatulate resting spores and discharged sporangia. × 250.

TYPE SPECIMENS OF CERTAIN HYSTERIALES

G. R. Bisby

In a previous paper (**1**) the writer attempted to summarize the varied views regarding the classification of the Hysteriales, or Hysteriaceae. In order to disentangle the confused nomenclature of these fungi, it is necessary to examine type specimens, most of which are in Europe. The following brief notes deal only with some of the specimens representing names that have been in the literature for many years.

The writer has thus far studied only certain corticolous and lignicolous Hysteriales. Hoehnel (**3**) proposed limiting the group to the eleven genera partially summarized at the end of this article. This is, however, doubtless too great a limitation. It would seem advisable, for the present at least, to follow the more common usage and include in the Hysteriales several other genera, some of which are folicolous, as has been done by Clements and Shear in their "The Genera of Fungi."

Type specimens and other material have been examined at Kew, the British Museum (Natural History), Berlin, and Paris. Considerable material from other sources has also been seen, and several species have been collected in the field. Notes were taken on the external features of the fruit bodies (hysterothecia), and the minimum amount of type material that would suffice was mounted and the microscopic characters noted. The final compilation of this paper was made at Winnipeg from the data and slides obtained in Europe, and the specimens and literature available here. Many names have had to be left for possible further consideration, and much critical or type material has of course not yet been examined at all.

The modern emphasis upon spore characters has tended to minimize the attention paid to hysterothecial characters in the diagnosis of these fungi. Schweinitz, Fries, and other earlier mycologists based their descriptions almost entirely upon the hysterothecia; but the difficulties of this method may be judged

from the entry below under *Hysterium elongatum*. As a matter of fact, the shape, size, arrangement, polish, and striations of the hysterothecia, the amount of opening of the longitudinal groove, and even the occurrence or amount of subiculum, vary within considerable limits with the nature of the substratum, the growing conditions, and the age or maturity of the specimens. The spores are more constant (provided they are mature), and their septation is especially reliable.

The eleven genera noted at the end of this paper were found (**1**, p. 186) to include about 300 species names compiled in the first twenty-two volumes of Saccardo's Sylloge. Many other species have been described more recently. Ellis and Everhart (**2**) in 1892 recorded 66 apparently good species in these genera in North America. Rehm (**6**) and Massee (**5**) list, however, only 29 and 17 species respectively for the areas they cover. There are certainly many superfluous names, some of which are mentioned below.

Schweinitz (**7**, **8**) collected and named many of these fungi. Shear and Stevens (**9**) have explained how his specimens come to be in the larger European herbaria. The study of Schweinitz' specimens is necessary in order to understand the American species, and the names to apply to them. There are hundreds of other important specimens in the herbaria visited, only a fraction of which are represented in this account dealing with about eighty-five names.

The interpretation of the species mentioned herein requires that larger compilations (**2**, **6**, **5**, Saccardo's Sylloge, etc.) be used for supplementary data. The specific names are arranged alphabetically in italics, those that presumably should be discarded are enclosed in brackets; doubtful names are preceded by a question mark; all are summarized at the end of the paper.

Hysterium abbreviatum Schw. The specimen at Kew from Schweinitz' herbarium consists of a small piece of wood with a few short hysterothecia, and two fragments of wood without the fungus. The hysterothecia are gregarious, erumpent-superficial amongst and parallel with the fibres of the old wood, about ½ mm. long, broadly elliptic, black, carbonaceous, not noticeably striate. The asci are cylindric, 8 spored, uniseriate; pa-

raphyses filiform. Spores 6–8×2–3 μ, hyaline, with one median septum.

Ellis and Everhart (**2**, p. 682) list "*Hysterium abbreviatum* in Herb. Schw." as a synonym of *Glonium parvulum*. The specimen at Kew is also very evidently *G. parvulum*. Schweinitz' name is much older than that of Gerard, but the latter is in common use and should perhaps be conserved.

Glonium accumulatum Schw. The Schweinitz specimens at Kew and the British Museum are *G. stellatum*.

Hysterium acerinum Westend. A specimen at Kew "ex herb. Westendorp" is typical *H. pulicare*.

Hysterium acuminatum Fries. Type not examined, but Rehm's Ascom. *125* has small spores 13–16 × 5–6 μ, 3 septate, uniformly brown. Fuckel's Fungi Rhenani *750* on *Fagus* was found, however, to be typical *H. pulicare*. Rehm (**6**, p. 15) interprets *H. acuminatum* as a small-spored alpine species on conifers. It is related to *H. pulicare*, especially to *H. angustatum*, but seems sufficiently different in possessing small spores and a coniferous substratum.

"*Hysterium acuminatum* Herb. Schw. *5642*" at Kew has brown spores 16–23 × 7–8 μ, with 4 to 6 cross septa and one or two longitudinal septa, and a slight median constriction. As Ellis and Everhart stated (**2**, p. 702) it is a *Hysterographium*, and not the *Hysterium acuminatum* of Fries; they regard it as a synonym of *H. subrugosum*, but the specimen examined at Kew seems to be *H. Mori*.

Ostreichnion [*Ostreion*] *americanum* Duby. Type not seen. Ravenel's specimen *1456* from Carolina, which was used by Cooke for illustration in Grevillea **4**: *pl. 67, fig. 1*, has spores up to 120 × 35 μ, with as many as 19 septa, end cells often paler, spores sometimes slightly constricted at the center. Massee (**5**, p. 28) says that the spores are "muriform." There are indications of longitudinal septa in the dark cinnamon brown spores of Ravenel's collection, but they seem to be only pseudosepta. A specimen from Ravenel at Berlin is the same as that at Kew. Massee (l.c.) reports this fungus for England, but English and continental specimens under the name *O. americanum* Duby at Kew in no case yielded spores resembling the striking

ones found in Ravenel's specimen and in Schweinitz' "*Lophium Sassafras*."

Hysterium angustatum Alb. & Schw. This name refers to the fungus similar to *H. pulicare*, but with spores uniformly brown and somewhat smaller. Rehm (**6**, pp. 14–15) convinced himself that it is distinct.

[*Hysterium Azaleae* Schw.] One specimen at Kew from Herb. Schw. consists of a split branch of *Azalea* with elongated black structures breaking through the epidermis. No asci or spores were found. Another specimen marked "in Az. nudif. Penn. Michener" has only a thin blackish incrustation in spots on the surface.

?*Hysterium Berengerii* Sacc. A specimen at Kew, "in Fraxino, Treviso, Saccardo," has a few rather large, superficial, sessile, linear, black, carbonaceous hysterothecia, with the ends obtuse, groove conspicuous; spores 35–40 × 9–11 μ, dark brown, with 5–8 septa, one cell of the spore commonly larger. The hysterothecia and spores are somewhat larger than in the Schweinitz type of *Hysterium insidens*, but the Saccardo material at Kew agrees well with other American collections that have been considered *H. insidens* (see **2**, p. 696).

Hysterium betulignum Schw. A specimen at Berlin has spores 20–22 × 7–8 μ, 3 septate, with the terminal cells paler. It is *H. pulicare*, as Ellis and Everhart report (**2**, p. 693) from an examination of the Schweinitz specimen at Philadelphia.

Hysterium biforme Fries. The specimen of Fries' Scl. Suec. *329* at Kew has 3-septate spores 27–34 × 6–8 μ, with the end cells slightly paler. This is *H. pulicare*. The specimen of No. *329* at Paris is the same.

Gloniopsis biformis Sacc. Type not seen, but apparently Saccardo described specimens which he judged from external appearance to be the "biforme" of Fries. As Rehm suggests (**6**, p. 18), it is probably the same as *Gloniopsis curvata*.

Hysterium (*Hysterographium*) *Ceanothi* Phill. & Hark. Type material at the British Museum and at Kew ("*2540* bis on *Ceanothus*, Harkness") has hysterothecia like those of *H. flexuosum* from Schweinitz, and spores 44–58 × 9–12 μ, up to 15 septate and muriform, brown, with a gelatinous envelope around

the spore. The spores are slightly narrower than in the type of *Hysterographium flexuosum*, but it is undoubtedly that species.

Hysterium chlorinum Berk. & Curt. The type of this species at Kew is externally and microscopically like *H. Cyrillae*. The original description gives the spores as ".003 long": this is 75 μ, but is given by Saccardo and by Ellis and Everhart as 7.5 μ. Spores were found up to 72 μ, with two unequal cells. The name is a synonym of *Glonium Cyrillae*.

?*Hysterium cinerascens* Schw. Represented at Kew by a fragment of wood 17 × 4 mm. with about 30 hysterothecia. The wood is considerably decayed, light brownish except between the hysterothecia, where it is cinereous. Hysterothecia closely gregarious, linear, dull black, ½–2 × ¼ mm., groove closed or becoming open. A specimen under the microscope showed a few young, thick-walled asci, with spores very indefinite, and only a few are developed far enough to show a septum or two.

The specimen at Berlin, from Schweinitz from Link's herbarium, has a good number of hysterothecia, but the ones mounted were also immature and showed no spores.

Ellis and Everhart (**2**) found the specimens at Philadelphia to be in poor condition, although they report muriform spores, stated on p. 703 to be brown, and at the bottom of p. 675 to be hyaline. *H. cinerascens* must still remain in the doubtful group. As for Duby's description of Schweinitz' specimen (see **2**, p. 675), it seems likely that the spores were "continuous" because immature, and that *Schizothyrium cinerascens* and *Henriquesia cinerascens* are meaningless names.

[*Hysterium confluens* Schw.] A specimen at Kew (No. *5689*) is a thin splinter of wood 12 × 3 × ½ mm. with about 75 blackish incrustations, some 7 of which show resemblance to hysterothecia (although rather too flat) and are ½–1 × ⅓ mm. A more promising looking specimen was mounted, but revealed no sign of ascus or spore.

?*Gloniopsis connivens* (Cooke & Hark.) Pazschke. Specimens at Kew on *Ceanothus* from Harkness marked "*Hysterium connivens*" are somewhat immature, the asci 110–130 × 14–16 μ, 8 spored, uniseriate-overlapping; spores 16–21 × 7–10 μ, ends obtuse and rounded, hyaline, with 5–7 cross septa, and one or

two divisions have longitudinal septa. An illustration at Kew is marked "perhaps at length coloured." A specimen of Rabenhorst-Winter Fungi Europaei *3677* labelled "*Gloniopsis connivens* (Cooke & Harkn.) ad ramulos emortuos Ceanothi . . . San Francisco Calif. leg. Harkness" has spores 18–24 × 9–10 μ, pale yellow, otherwise as above. *G. connivens* may be a distinct species, but its status is still uncertain.

Gloniopsis curvata (Fries) Sacc. Type not seen, but a number of European specimens considered to be this species have been examined, with spores 16–22 × 6–9 μ, 4–7 septate and muriform, hyaline to pale yellow, often slightly constricted at the middle, rounded but often narrowed at the ends, surrounded by a gelatinous envelope which soon disappears in water. Specimens from *Rubus*, *Quercus*, *Alnus*, *Crataegus*, and other deciduous trees or shrubs appear indistinguishable.

Hysterium Cyrillae Berk. & Curt. The type (Curtis *2747*) consists of three small twigs bearing a few scattered, erumpent-superficial hysterothecia, ½–1 × ¼–¾ mm., black, elliptical or oval, striate, cleft slightly open; asci 180–225 × 40–45 μ, 8 spored, biseriate; spores 54–82 × 13–17 μ, wall hyaline, spore contents pale greenish yellow, spore divided by a septum into two parts, one part nearly twice as long as the other, somewhat constricted at the septum. There is also at Kew a specimen of this species from Georgia.

Saccardo translated Berkeley's ".004 [inch] long" as 10 μ, as did Ellis and Everhart. It is really 100 μ, although no spore was seen which reached that length. The fungus has, however, striking spores. It is now called *Glonium Cyrillae* (Berk. & Curt.) Sacc.

?*Tryblidium dealbatum* Gerard. Type not examined, but a specimen at Kew labelled "ad corticum Syringae. Ex herb. W. R. Gerard" bears, on the whitened surface of the wood, several superficial apothecia (the cups are as in *Tryblidium*, and are too open for a *Hysterographium*). The spores are 23–27 × 12–14 μ, pale yellow, 5–6 septate and muriform. Cooke made the combination *Tryblidium Syringae* (despite the fact that the spores of *Hysterium Syringae* Schw. are unknown), presumably because both are on the same host and there is a certain amount of

resemblance in the fruit bodies. Gerard's type specimens, and those examined by J. B. Ellis (**2**, p. 701) which were found to have spores "becoming dark brown and almost opaque," need to be studied, but it seems doubtful that the fungus is one of the Hysteriales.

Lophium decipiens Karst. (*Mytilidion decipiens* (Karst.) Sacc.). See *M. tortile*.

Hysterium depressum Berk. & Curt. The type at Kew is labelled in Berkeley's writing "*3297 Hysterium depressum* B. & C. Virginian mountains" and has a drawing by Berkeley of a young ascus and 4 spores. The specimen consists of two bits of wood bearing several hysterothecia which are superficial, gregarious, straight, boat shaped, ½–1¼ × ⅓ mm., dull black, not definitely striate, nor is the "granulato-rugosum" of the original description a noticeable feature. The groove is closed or in some cases becomes opened slightly. The asci are immature, with the spore-bearing portion 70–75 × 19–24 μ, 8 spored; the spores 30–37 × 6–7½ μ, 7–9 septate, with one cell usually enlarged, pale greenish yellow because of immaturity; paraphyses filiform. The original description gave the spores as ".0016 long" which Ellis and Everhart (**2**, p. 695) erroneously translate as 30 μ, but Saccardo compiled correctly as 40 μ. The writer's examination did not reveal a spore quite that long. It seems evident that the specimens represent somewhat young *Hysterium insidens*.

Hysterium elongatum Wahl. Type not seen, but a specimen at Paris marked No. *62* (from Fries?) has elongated hysterothecia and nearly opaque spores 32–45 × 10–14 μ, 7–11 septate and muriform. Fuckel's Fungi Rhen. *1754* at Kew is similar. This fungus (*Hysterographium elongatum* (Wahl.) Corda) is recorded as rare in Europe. It has been reported from North America, first by Schweinitz, but his specimens at Kew and (see **2**, p. 706) at Philadelphia are without spores. Berkeley (Grevillea **4**: 10) lists for *H. elongatum* from Carolina the following specimens sent by Curtis: Nos. *171*, *184*, *270*, *442*, *714*, *882*, *904*. These numbers are all at Kew, and were examined.

No. *171* has spores 37–42 × 7½–10 μ, 6–11 septate, one cell large: evidently *Hysterium insidens*.

No. *184* has large spores 63–72 × 18–24 μ, with 7 septa, 1 central and 3 near each end, as in *H. magnosporum* Gerard.

No. *270* has young spores about 30 × 10 μ, and is possibly *Hysterographium subrugosum*.

No. *714* has 3-septate spores 13–16 × 5–6½ μ, and is doubtless *Hysterium angustatum*.

No. *882*, with spores 21–26 × 7–9 μ, 3–7 septate and muriform, is no doubt *Hysterographium Mori*.

Nos. *442* and *904* seemed to be without spores. Another American specimen at Kew, No. *43* from Peck, on *Quercus*, is labelled *H. elongatum*, but is *Hysterographium flexuosum*. It seems doubtful that *H. elongatum* really has been found in America.

Hysterium Eucalypti Phill. & Hark. Material at Kew marked "*2405* on Eucalyptus, Harkness. Type" consists of 3 pieces of bark with hysterothecia erumpent, oval, ½–¾ × ¼ mm., dull black, carbonaceous, not striate, groove noticeable. The asci are 60–80 × 11–12 μ (spore bearing portion), 8 spored, biseriate; spores 16–21 × 5–6 μ, 3 septate, all cells usually uniformly brown. As Ellis and Everhart report (**2**, p. 693), this is *H. angustatum*.

Hysterium fibritectum Schw. The specimen at Kew marked "Herb. Schwein. *2680*" has beside it a drawing of three elliptical one-septate spores marked "colourless, 1-seriate." More than 100 hysterothecia occur on the piece of semi-rotted wood, and are small, 0.3–0.4 × 0.2–0.3 mm., erumpent, dull black, with a depressed groove. A mount showed young asci, but a few of the spores were mature enough to escape. The spores were 10–13 × 3–4 μ, hyaline, elliptical or fusoid, not constricted, with a median septum. The fungus at Kew is a *Glonium* resembling *G. nitidum* Ellis, and is on a substratum with bordered pits. Ellis and Everhart (**2**, p. 699) found the Philadelphia specimens "without fruit."

Hysterium flexuosum Schw. Co-type material at Kew bears several superficial hysterothecia 1–2 × ½ mm. The hysterothecia and spores are as in Schweinitz' specimen of *H. vulvatum* at Kew; the flexuous character of certain hysterothecia is an immaterial point in *H. flexuosum*. The fungus should be called *Hysterographium flexuosum* (Schw.) Rehm.

Hysterium formosum Cooke. The type (No. *1020*) consists of

pine twigs bearing superficial, irregularly placed, elliptical hysterothecia, 1–1½ × ½ mm., black, shining, striate, ends narrowed, groove closed; asci cylindrical, 150–160 × 12–14 μ, 8 spored, uniseriate; spores 18–24 × 7–10 μ, with 3 (sometimes 5) cross septa, one to three cells faintly longitudinally septate, slightly constricted in the middle, brown. No. *1028* on *Juniperus* is similar, except that the spores are slightly smaller; Ellis and Everhart, N. A. Fungi, 2d ser. *2062* is like the type but with some spores 6 septate. This fungus, *Hysterographium formosum* (Cooke) Sacc., is very near *H. Mori*. The description of *H. pumilionis* Rehm (**6**, p. 21) would fit *H. formosum* exceedingly well; it also is alpine.

Hysterographium Fraxini (Pers. ex Fries) de Not. Type not seen, but the name refers to a fungus widespread on ash, less common on other hosts.

Hysterium fusiger Berk. & Curt. The type at Kew from New England (Sprague No. *5830*) is a piece of wood with five hysterothecia on the blackened surface. These are ½–1 × ⅓–½ mm., oval, black, somewhat striate, with the groove nearly closed. The asci are 120–140 × 13–18 μ, ending in a short stalk, 8 spored, biseriate; paraphyses numerous, projecting above the asci, filiform; spores 31–42 × 7–9 μ, brown, 6–9 septate, one cell sometimes larger. Berkeley remarked, "Resembling somewhat *H. tortile* and *graphicum* [*i.e.*, *Mytilidion tortile* and *Glonium graphicum*] but with different sporidia." The hysterothecia are not conchiform like those of *Mytilidion*, and the species seems to be *Hysterium insidens*.

Hysterium Gerardi Cooke & Peck. The type from Peck marked "*123* on old decorticated trunk of Chestnut *Castanea vesca* Poughkeepsie, N. Y. W. R. Gerard legit" bears several superficial, gregarious hysterothecia, ellipsoid or elongated, straight or curved, ends narrowed, ½–1¼ × ¼–⅓ mm., dull black, groove closed. Spores 16–20 × 7–8 μ, with 3 to 6 cross septa, and one or two cells with longitudinal septa. As Ellis and Everhart state (**2**, p. 703–4), it is *Hysterographium Mori*.

Hysterium graphicum Fries. Type not seen, but the name *Glonium graphicum* (Fries) Duby is used for a species which occurs in Europe on conifers. We have seen no American

specimens. Schweinitz' specimen at Kew so labelled, on *Sassafras*, seems to be *Hysterium pulicare*.

?*Hysterographium guaraniticum* Speg. Type not seen. B. Balansa in Pl. du Paraguay No. *3953* has distributed under this name specimens with crowded, superficial hysterothecia, ¾–1¾ × ½ mm., black, groove narrow; spores 16–21 × 6–8 μ, 3–5 septate with one to three cells having longitudinal septa. This is doubtless *H. Mori*.

?*Hysterium hiascens* Berk. & Curt. The type was not found at Kew. Berkeley noted "disco aperto" and thought it allied to *Tryblidium rufulum*. Ellis and Everhart (**2**, p. 707) base their description on Rehm's Ascomycetes No. *314*. This exsiccatum at Kew has spores somewhat larger (26–34 × 10–13 μ) than given in Ellis and Everhart, but is otherwise similar. The spores become dark brown, almost opaque. The status of the name, and of the species, is uncertain. (See **6**, p. 21.) It would seem possible that No. *314*, which has been called "*Hysterographium hiascens* Rehm," might be *H. subrugosum*. *Hysterium hiascens* Berk. & Curt. is a *Blitridium*, according to Rehm (l.c.).

?*Hysterium hyalinum* Cooke & Peck. The type at Kew is marked by Peck "*47 Hysterium Rousselii*? immature on wood of some deciduous tree Cold Spring, N. Y., June. Does not appear to be well developed, but I send it for what it is worth. C. H. P." After "immature" he has a drawing of a spore which looks like *Hysterographium Mori*. Three hysterothecia were examined, but all were immature and unsatisfactory; the spores are becoming brown, 20–23 × 7–8, 3 septate. It does not look like *Hysterium pulicare;* it may indeed be young *Hysterographium Mori* as Peck intimates.

A specimen from Gerard, No. *124*, in the *H. hyalinum* folder at Kew, is young *Hysterographium Mori*.

A specimen from Ellis in the same folder has hyaline immature spores.

Glonium hyalosporum Gerard. Type not seen, unless a specimen at Kew from Gerard is part of the type. This consists of a piece of gnarled wood with straight or flexuous hysterothecia bearing small spores mostly immature and pale, but some of them are mature enough to be brown and appear to be typical

Hysterographium Mori. Ellis and Everhart (**2**, p. 708) found the spores to become brown in a specimen of "*Hysterium hyalosporum* Ger."

Hysterium insidens Schw. The Schweinitz specimen at Kew consists of a small splinter of wood bearing a number of gregarious, superficial, small hysterothecia, oval to elliptical, straight or slightly curved, dull black, not striate, groove noticeable. The spores were found to be 24–33 × 7½–9 μ, cinnamon brown, 5–8 septate, one cell often enlarged. This specimen at Kew agrees well with that of Schweinitz at Philadelphia, as described in Ellis and Everhart (**2**, p. 696). This species is a fairly common one, with hysterothecia and spores often somewhat larger than in the type.

A Schweinitz specimen at Berlin marked *H. insidens* consists of bits of wood bearing stromata resembling those of young *Hypoxylon* or *Diatrype*. It may have been the occurrence of this stroma on part of his specimen which led Schweinitz to remark "insidens crustae longe effusae nigrae." No hysterothecia were seen on the Berlin specimen.

Cooke (Grevillea **17**: 58) mismeasured the spores of the Schweinitz specimen at Kew as "45–50 × 15 μ."

Hysterographium (*Gloniopsis*) *insigne* Cooke & Hark. Type material at Kew consists of gregarious oval to elongated hysterothecia, ½–1 × ¼–⅓ mm., ends rounded, black, scarcely striate or shining, cleft somewhat open at maturity; spores 17–22 × 7–9 μ, 5–7 septate and muriform, nearly hyaline, narrowed at the ends but not acuminate, slightly constricted at the middle. This fungus (*Gloniopsis insignis* (Cooke & Hark.) Berl. & Vogl.) is not conspicuously different from *G. curvata* as found in England.

[*Hysterium Kalmiae* Schw.] The Schweinitz specimen at Kew consists of two small pieces of a branch with several elongated black structures superficially resembling *Hysteria*, but no spores were found.

Hysterographium kansense Ellis & Ev. Type not seen, but Ellis & Ev., N. A. Fungi, 2d ser. *3037* "on bark of living *Quercus macrocarpa*, Rockport, Kansas, May 1893, E. Bartholomew" (the original collection was as above, but in Feb. 1893), has spores 26–34 × 9–12 μ, and does not seem to be specifically distinct from *H. subrugosum*, which also occurs on oak.

Hysterium Lesquereuxii Duby. Specimens "ad ramos *Gleditsiae* prope Columbus (Ohio), Am. Bor." at Kew and the British Museum, and a similarly labelled specimen from Duby at Paris, which are all perhaps co-type material, consist of pieces of small branches bearing erumpent-superficial hysterothecia, 1–1½ × ½ mm., scattered or crowded together, straight or curved, cleft noticeable. Asci about 110 × 15 μ, 8 spored, biseriate; spores 18–25 × 7–10 μ, brown, 3–7 septate with one to three of the cells having longitudinal septa; spores constricted at the middle. These specimens agree well with those from Louisiana described in Ellis & Everhart (**2**, p. 705). The fungus seems to be a well developed *Hysterographium Mori.*

[*Hysterium librincola* Schw.] The specimen at Kew from Schweinitz consists of a piece of stem 50 × 3 mm. with a few elongated fruit bodies. The shape doubtless led Schweinitz to refer the fungus to *Hysterium;* but no groove is evident, and the fungus is one of the Imperfecti, with conidia 4–6 × 3–4 μ, commonly with 4 cells remaining attached together. It is perhaps *Hormiscium hysterioides* (Corda) Sacc.

Hysterium lineare Fries. A specimen at Kew, No. *90* from Fries (Scl. Suec.?), did not yield spores. The species is, however, considered common in Europe and America, and is now known as *Glonium lineare* (Fries) de Not.

Hysterium Lonicerae Phill. & Hark. Material at Kew marked "on *Lonicera*, Harkness *2472* Type" consists of two pieces of branches with many superficial, gregarious or scattered hysterothecia, ½–1½ × ⅓–½ mm., linear to oval, dull black, cleft closed; asci 100–125 × 15–24 μ, 8 spored, 1–2 seriate; spores 22–29 × 6–12 μ, 5–7 septate and muriform, hyaline to pale yellow. The spores are rather immature, but the fungus cannot be very different from *Gloniopsis Verbasci.*

Hysterium macrosporum Peck. A bit of material "ex type, N. Greenbush, N. Y., on pine wood, C. H. Peck" was obtained through the kindness of Dr. House. The fungus is as described by Peck, and more fully by Ellis (**2**, p. 694), except that some of the hysterothecia exceed one millimeter in length. The spores are fusoid with rounded ends, clear chestnut brown, with the three septa about evenly spaced. A good species, differing

especially in the septation of the spores from *H. magnosporum* Gerard on deciduous wood. The spores are considerably larger than in *H. thujarum*.

Hysterium magnosporum Gerard. A specimen from Gerard at Kew has four hysterothecia which fit the description in Ellis and Everhart (**2**, p. 694). A drawing beside the packet shows a seven-septate spore, the two central cells somewhat larger. Data by W. Phillips at Kew give the spores as 48–67 × 15–20 μ. The four hysterothecia were not disturbed by the writer, but the species appears to be a good one. Curtis evidently collected it in Carolina: see under *H. elongatum* above.

Hysterium (*Glonium*) *medium* Cooke. The type at Kew (No. *293* from Ravenel) bears superficial gregarious hysterothecia ⅛–1½ × ¼–½ mm., dull black, striate, groove closed; spores uniseriate or overlapping, 6–8½ × 3 μ, hyaline, 2-celled. The hysterothecia are in some cases larger than is usual in *Glonium parvulum;* there is no definite subiculum present, but that is a variable feature of *G. parvulum;* the two names are doubtless synonymous, as Lohman (**4**) has concluded.

Hysterium Mori Schw. Material from Schweinitz was not found at Kew, the British Museum, Berlin, or Paris. Ellis and Everhart report (**2**, p. 704) that satisfactory material was found in the Schweinitz herbarium. European herbaria contain a few specimens from North America, where the fungus is common. When found in Europe it is called *H. Rousselii*, for as Ellis and Everhart state, there seems to be no difference. Both belong to *Hysterographium*.

Lophium mytilinum Pers. ex Fries. A specimen of Fries Scler. Suec. *60* at Kew bears young long spores. While this particular specimen is not very satisfactory, the name applies to a definitely recognized fungus on coniferous bark and wood in Europe and North America.

?*Hysterographium naviculare* Karst. Specimens at Berlin, ex herb. Winter, on *Prunus Padus* from P. A. Karsten, were found to agree very well with the description (**6**, p. 20) of *H. Rehmianum* Sacc., except that the spores become nearly opaque.

Lophium naviculare Schw. The Schweinitz specimen at Kew consists of about 40 superficial non-conchiform hysterothecia

1–2½ × ½–¾ mm., with spores up to 64 × 17 μ, and muriform. It is *Hysterographium flexuosum*.

Glonium nitidum Ellis. Material of this fungus was sent to Cooke, and published in Cooke and Ellis (Grevillea **8**: 13), but the species was credited to Ellis alone. The type or co-type specimen at Kew is labelled "*3016. Glonium* on fir wood Newfield, J. B. Ellis." The host was determined for the writer at Kew to be *Cupressus* (*Chamaecyparis*), not fir. The hysterothecia are very small, ⅛–⅓ × 1/10–1/5 mm., somewhat erect, densely aggregated, superficial, oval, faintly striate, with a crest longitudinally along the top, the groove closed. Spores 6–8 × 2–2½ μ, 2-celled, not constricted at the septum, hyaline with a yellowish tinge. In the specimen of Ellis' N. Am. Fungi *270* at Kew the spores are slightly larger, 8–10 × 2½–3 μ, and also have a dilute brownish tinge. A specimen from Ellis at Berlin, collected Nov. 14, 1893, has still larger but similar spores up to 13 × 3 μ, and with a distinct brownish colour. This species is easily distinguished from *G. parvulum* by the non-constricted spores which become somewhat longer, and by the host. The dilute brown colour of the spores is not sufficiently marked to remove the species from *Glonium*.

Hysterium nova-caesariense Ellis. Type not seen. C. Roumeguère Fungi Sel. Exs. *4854* on pine bark from Ellis agrees with the description in Ellis and Everhart (**2**, p. 703), as does the Kew example of Rehm's Ascom. *313*. The spores have no constriction. It appears to be a good species. Saccardo transferred it in error to *Mytilidion;* it is *Hysterographium novacaesariense* (Ellis) Roum.

[*Hysterium nucicola* Schw.] The parts of the original material at Kew and Berlin bear a number of small hysterioid bodies, but no spores were found.

?*Hysterium ovatum* Cooke. The type from Ravenel at Kew is very unsatisfactory: only a few immature hyaline triseptate spores 15–18 × 7–8 μ were found. Apparently a considerable collection of this was made by Ravenel, since his Fungi Am. *321* seems to be the same, but no asci or spores were found in this material at Kew. Cooke's sketch with the type shows non-septate nucleate spores. *H. ovatum* must be left in the doubtful group.

Hysterium (*Glonium*) *parvulum* Gerard. A specimen at Kew from Gerard on *Alnus*, Poughkeepsie, may be co-type material. This is evidently the fungus described by Gerard, and more fully by Ellis and Everhart (**2**, p. 682), and recently studied carefully by Lohman (**4**). A specimen from the Herb. State Botanist, Albany, N. Y., marked "probably co-type material" also has the hyaline 2-celled spores, 7–8 × 3 μ, characteristic of *Glonium parvulum* (Ger.) Cooke.

Hysterium praelongum Schw. Co-type material at the British Museum and at Kew consists of bits of wood bearing several erumpent-superficial, gregarious hysterothecia, long (1½–4 × ½ mm.; Schweinitz reported them up to 6 lines = 12 mm.!), straight or flexuous, dull black and somewhat striate, cleft conspicuous. The spores appear somewhat immature, and are 20–30 × 8–12 μ, 5–8 septate and muriform, hyaline, or pale yellow. Ellis and Everhart (**2**, p. 709) are correct in considering this to belong to *Gloniopsis Verbasci* (Schw.) Rehm, although "praelongum" is the earlier name.

Hysterium prominens Phill. & Hark. The type at the British Museum consists of several scattered, superficial hysterothecia, ½–1¼ × ⅓–½ mm., dull black, cleft becoming somewhat open. A specimen under the microscope showed only immature, rather small, muriform spores. Co-type material at Kew showed also the same young spores. The original description, however, gives the spores as 40–50 × 10 μ, constricted at the centre, 7–11 septate, brown; Ellis N. Am. Fungi *2064* on the same host (*Salix lasiolepis*), also from California, sent by Harkness, has spores up to 64 × 14 μ, 11–14 septate and muriform, constricted at the center, with a gelatinous envelope. No. *2064* is *Hysterographium flexuosum*. The original description also suggests *H. flexuosum*.

Hysterium pulicare Pers. ex Fries. Fries Scler. Suec. *61* at the British Museum has spores 21–33 × 7–9 μ, 3 septate, center cells chestnut brown, end cells usually paler. American specimens commonly have smaller spores. Fries Scler. Suec. *91* "*Hysterium pulicare β betulinum* Kunze" has similar spores, but somewhat smaller. His Scler. Suec. *92*, var. *lenticulare*, at the British Museum did not yield spores, but this variety from this

exsiccatum number is illustrated at Kew as having spores like the type. Varieties based on the shape and size of the hysterothecia are of little validity, except for the form *pedicellatum*, which is striking. Specimens of the varieties *laeve* and *augustatum* from Schweinitz are at Kew, but mature spores were not found. See *H. angustatum* and *H. acuminatum* above. *H. pulicare* is widespread on deciduous trees.

Hysterium putaminum Cooke. The type (No. *2603* from Aiken, S. Car.) consists of several broken pieces of peach stones. A half-stone placed in a separate packet bears on its inner surface several superficial, gregarious or scattered hysterothecia, ¼–¾ × ⅛–¼ mm., dull black, cleft nearly closed; asci 70–80 × 15–18 μ, 8-spored, biseriate; spores 18–22 × 7–8 μ, brown, 3–5 septate with one or two cells having longitudinal septa; spores somewhat constricted at the middle. It appears to be *Hysterographium Mori*, the hard substratum probably accounting for the small hysterothecia.

?*Glonium Ravenelii* Cooke & Phill. Type material sent to Cooke, marked in Ravenel's writing "*3028* on bark of *Platanus occidentalis* March 1880, Seaboard of S. C., H. W. R.," is at Kew. Part of this collection was distributed later by Ravenel as his Fungi Am. *763*, with the name *Glonium Ravenelii* Cooke & Phill. The specimens are as described in Ellis and Everhart (**2**, p. 684); a slight subiculum occurs only occasionally. The specimens examined were without definite spores. Part of the same collection, obtained from the Herb. State Botanist, N. Y., was carefully studied, but no well formed spores were found.

Hysterium repandum Bloxam. The type at the British Museum, and some twenty small packets of this distinctive fungus at Kew, have been examined. All are apparently from Bloxam's collection on rotten stumps, Orton Wood, near Twycross, Leicestershire, England. Reported also from Belgium. No specimens were seen at Paris. The fungus is now called *Farlowiella repanda* (Blox.) Sacc.

[*Hysterium Rhois* Schw.] Co-type material at Berlin shows no true *Hysterium*, but only a few vague blackish bodies, perhaps stromatic in nature.

Hysterium Rousselii de Not. Type not seen, but specimens

in European herbaria appear identical with *Hysterographium Mori*.

[*Hysterium rugulosum* Schw.] Co-type material at Kew consists of a piece of wood 19 × 4 × 4 mm. with about 25 hysterothecia ½–1 × ¼ mm., massed together, oval, groove closed. No spores were found. Berkeley has a note beside the specimen, "no spores seen."

[*Hysterium Sambuci* Fries.] A specimen from Schweinitz at Kew bears a few obscure black structures, but nothing resembling a *Hysterium*, nor were spores found.

Lophium Sassafras Schw. The Schweinitz specimen at Kew bears about a dozen superficial, rather erect hysterothecia, 1–2 × ½–¾ mm., black, striate, groove closed; asci about 280 × 30 μ with 4 overlapping spores which are 81–107 × 23–30 μ, becoming opaque cinnamon brown and up to 18 or 20 septate, the end cells often lighter in colour. This is *Ostreion americanum* as represented at Kew.

Glonium simulans Gerard. A specimen at Kew labelled "North American Fungi No. *136*, W. R. Gerard, Poughkeepsie, N. Y." bears gregarious or scattered superficial hysterothecia, ¾–1½ × ⅓ mm., striate, linear with obtuse ends; spores 11–16 × 4 μ, hyaline, 2-celled, slightly constricted. This appears to be a distinct species.

Glonium stellatum Muehlenb. A specimen from Schweinitz at Kew is as described in Ellis and Everhart (**2**, p. 680) and elsewhere. The spores were found to be 20–28 × 4–6 μ. It is a common species in North America.

?*Hysterium* (*Hysterographium*) *stygium* Cooke. Type material at Kew from Ravenel (Nos. *3046*, *3047*, *3048*) consists of whitened lichen-covered wood bearing fruit bodies becoming cupulate, ½–1 × ½ mm.; spores not in good condition, but some were found 30–40 × 14–20 μ, yellowish, muriform. Ellis and Everhart (Erythea II, p. 23) report that authentic material was "almost pezizoid" with asci 75–80 × 22–25 μ and spores 25–30 × 12–14 μ. The fungus is not a good member of the Hysteriales: possibly *Blitridium hiascens* (Berk. & Curt.) Sacc. A specimen at Berlin from Missouri (Demetrio) marked *H. stygium* failed to yield good spores.

Hysterium subrugosum Cooke & Ellis. Type material at Kew is as recorded in Ellis and Everhart (**2**, p. 702), except that the asci and spores were found to be somewhat longer (asci 85–90 × 18–27 μ, with a short stipe about 15 μ long; spores 27–33 × 10–12 μ, not constricted, chestnut-brown). Ellis' N. A. Fungi *459* at Kew was found to agree. Illustrated by Cooke (Grevillea **5**: *pl. 81, fig. 1*) but the spores are given by him in error as 45 × 15 μ. This fungus, *Hysterographium subrugosum* (Cooke & Ellis) Sacc., differs from *H. Mori* in possessing larger, non-constricted spores.

Hysterium (*Gloniella*) *sycnophilum* Cooke. The type from Ravenel at Kew is marked in Massee's writing "a lichen! *Opegrapha varia*." Ellis and Everhart also found specimens from Ravenel to be *Opegrapha*.

[*Hysterium Syringae* Schw.] Co-type material at Kew consists of 3 pieces of old wood, each bearing a number of superficial hysterothecia, gregarious or scattered, oval to oblong, ends rather abruptly rounded, ½–1 × ¼–½ mm., black, groove not opened. No spores were found, and Ellis and Everhart (**2**, p. 702) report none for material in the Schweinitz herbarium. See *Tryblidium dealbatum* above.

Hysterium thujarum Cooke & Peck. The specimen at Kew, probably the type, is labelled only "*H. thuiarum* C." and consists of a piece of bark bearing a number of superficial, scattered or gregarious hysterothecia, ½–1½ × ⅓–½ mm., oval to linear, rounded or pointed at the ends, dull black, not or faintly striate, cleft not conspicuous and nearly closed; asci 150–160 × 16–19 μ, with a curved stalk about 50 μ long, with 8 or fewer spores, uniseriate and overlapping; spores mostly 30–34 × 12–13 μ, but ranging from 26–40 × 10½–15 μ, nearly always 3 septate, sometimes 4 or 5 septate, fusoid, becoming dark chestnut brown throughout.

On the same sheet at Kew is a specimen "on bark of *Thuja occidentalis*, New Baltimore, June, Dr. E. C. Howe legit" which bears the same fungus. A specimen on the same host from Manlius, N. Y., C. H. Peck, from Herb. N. Y. State Botanist, has also been examined, but is without spores.

Hysterium thujarum differs from *H. macrosporum* Peck in possessing smaller spores.

Hysterium tortile Schw. A specimen from Schweinitz at Kew bears several erect, gregarious, superficial hysterothecia 1–1½ × ½ mm., elliptical, faintly striate, black, groove closed. The asci are about 100 × 6 μ (spore bearing portion), cylindrical; spores uniseriate or somewhat overlapping, 13–16 × 4–5 μ, brown, 3 septate, mostly not constricted at the septa. The specimen examined was in excellent condition. The fungus is now called *Mytilidion tortile* (Schw.) Sacc. European specimens labelled "*M. tortile*" were, so far as seen, another fungus with much larger spores. *M. decipiens* (Karst.) Sacc., as represented by Karsten's Fungi Fennici *767* at Berlin, also has 3-septate brown spores 12–16 × 4–5 μ, although the hysterothecia are smaller than those of the type of *M. tortile*.

Hysterium truncatulum Cooke & Peck. The type specimen at Kew (Peck *165*) consists of a bit of old wood bearing a number of oval to elliptic superficial hysterothecia, ½–1 × ⅓–½ mm., striate, dull black, groove narrow. Asci were found to be 100–110 μ long (spore bearing portion), biseriate, spores 27–30 × 6½–9 μ, 3 septate, chestnut brown with terminal cells lighter in colour. Phillips' notes at the British Museum give the spores as 25–30 × 5–10 μ, to which he added "= *H. pulicare*" and Cooke has added a memorandum "Yes M. C. C." Cooke's original description gave the spores as 35–40 × 10 μ, but this is too large. The fungus is typical *H. pulicare;* in many American and some European collections the spores are somewhat shorter.

Hysterium variabile Cooke & Peck. The type at Kew marked by Peck "*21* on old chestnut posts, Albany, May" bears many superficial hysterothecia, 1–2 × ½ mm., dull black, cleft noticeable but nearly or entirely closed; spores 16–22 × 7½–9 μ, with 4–6 cross septa and 2 or 3 cells having longitudinal septa, chestnut brown. Asci about 100 × 10 μ, short-stipitate, 8 spored, uniseriate or overlapping; paraphyses filiform. Another specimen at Kew "*37* . . . on dead decorticated branches of some deciduous tree, Albany, May, C. H. P." is marked by Cooke "*variabile* C. & P.? It is doubtful if this is not distinct from No. *21*." No. *37* has spores 17–21 × 7½–9 μ, as in No. *21*. Both are *Hysterographium Mori*. Specimens collected by Peck and labelled *H. variabile*, obtained from the Herb. State Botanist, N. Y., were also found to be *H. Mori*.

Hysterium varium Fries. Type not seen; according to Rehm (**6**, p. 235) this fungus is a *Tryblidiella*. Schweinitz recorded it from Pennsylvania, but his specimen at Kew could not be determined. A specimen from Curtis, considered by Berkeley to be *Hysterium varium*, seems to be *Ostreion americanum*.

Hysterium Verbasci Schw. Co-type material at Kew has a half dozen linear hysterothecia, 1–1½ × 1/5–⅓ mm., and several more immature ones. The asci and spores are immature even in the larger hysterothecium examined, and the septa were scarcely visible. Duby's description of Schweinitz' specimen was based upon similar immature material, and from Duby's report that the spores were continuous Saccardo transferred the species to *Schizothyrium*. Rehm (Hedwigia **25**: 147) found septa in Duby's material from Schweinitz, and reported it as *Gloniopsis*. The Schweinitz specimen at Berlin has, moreover, spores mature enough to escape readily from the asci; these are 22–26 × 8–10 μ, hyaline with a slight tinge of yellow, 7–8 septate and fenestrate. The fungus is a *Gloniopsis* (*G. Verbasci* (Schw.) Rehm). *G. decipiens* de Not. does not seem to be very different, but authentic specimens have not been examined.

Hysterium viticola Cooke & Peck. The type (Peck *124*) at Kew consists of two specimens. The first is labelled in Peck's handwriting "*Hysterium 124* on dead grape vine, Vitis, Poughkeepsie, N. Y., W. R. Gerard legit" to which Cooke had added "*viticolum*" after "*Hysterium*." No spores were found. The second specimen (which is doubtless really the type, since it has spores) is marked, also in Peck's writing, "*124* resent. *Hysterium* on dead grape vine Greenbush, N. Y., Oct. This is like Gerard's I suppose, which I sent as No. *124*. He sends very small bits . . . C. H. P." To this Cooke had also added "*viticolum*." In both specimens the hysterothecia are superficial, ½–1½ × ⅓ mm., black; in the second the spores are 16–21 × 7–8 μ, 3–5 septate with a couple of cells having longitudinal septa. Ellis and Everhart (**2**, p. 703–4) are correct in referring the species to *Hysterographium Mori*. A specimen "*Hysterium* on *Rubus* Ellis *2299*, New Jersey" also marked by Cooke "*viticolum*" (and which probably represents the "var. *ruborum* Cooke" of Rehm's Ascomycetes *364*) is also *H. Mori*. Several specimens collected by Ellis are filed under *H. viticolum* at Berlin.

Hysterium vix-visibile Gerard. Type not examined, but specimens from Gerard at Kew have pale brown spores 12–15 × 4½–5 μ, and small apothecia characteristic of *Hysteropatella Prostii*, as Shear noted (see his N. Y. Fungi *183*). Specimens from Sandlake, N. Y. (C. H. Peck), from the Herb. State Botanist, N. Y., also agree with *H. Prostii*.

Hysterium vulvatum Schw. A specimen at Kew from Schweinitz bears 5 hysterothecia 1–1½ × ½ mm., straight, cleft conspicuous; asci 120–150 × 30–40 μ; spores brown, 39–56 × 12–16 μ, 9–13 septate and muriform, constricted at the middle, with a gelatinous envelope around the spore. It is a *Hysterographium* (*H. vulvatum* (Schw.) Sacc. = *H. flexuosum* (Schw.) Sacc.), and is common in North America. *H. Rehmianum* is a somewhat similar species in Europe, but it apparently has smaller spores.

SUMMARY

This paper deals with some of the names that have been applied to certain lignicolous and corticolous Hysteriales. The eleven genera mentioned below were considered by Höhnel (**3**) to constitute the Hysteriales, but the common, and doubtless more correct, practise is to include several other genera in the group. Keys are provided by Rehm (**6**), by Ellis and Everhart (**2**), and by Clements and Shear in their recent "Genera of Fungi."

The characters of the hysterothecia are of diagnostic value, particularly in separating genera, but the spores provide the main differentiating features. The host or substratum should be identified in collecting the Hysteriales; one usually will find that species occurring upon conifers differ from those on deciduous plants, although a few species develop upon both types of substratum. Some confusion has resulted from the interpretation of immature spores temporarily hyaline as belonging to genera with spores permanently hyaline.

In the brief summaries given here of certain species, and based primarily upon examinations of type specimens, it must be remembered that few of the described species are included, and the distinguishing characters mentioned below are principally size of spores, type of host, and distribution. It is hoped, how-

ever, that the data presented in this paper may aid mycologists in determining some of the commoner Hysteriales.

1. *Bulliardiella* Sacc. was separated from *Mytilidion* because the spores are only two celled. Fungi belonging to this genus have not been examined by the writer.

2. *Dichaena* Fries, is not included in this article. Species of *Dichaena* are often easily recognized from their macroscopic appearance, but the microscopic characters are usually uncertain.

3. *Farlowiella* Sacc. consists of *F. repanda* (Blox.) Sacc. as the only well known species.

4. *Gloniella* Sacc. includes fungi with spores having three or more cells which remain hyaline; some species occur on herbaceous plants. No good species of *Gloniella* is discussed in this paper. *G. ovata* (Cooke) Sacc. is unsatisfactory; nor is it a good basis for Rehm's genus *Hysteroglonium*.

5. *Gloniopsis* de Notaris, corresponds to *Hysterographium*, except that the spores remain hyaline. None of the species mentioned herein were found upon conifers. *G. curvata* (Fries) Sacc. occurs in Europe and probably in North America, and has spores 16–22 × 6–9 μ. *G. biformis* Sacc. and *G. insignis* (Cooke & Hark.) Berl. & Vogl. may be synonymous names.

G. Verbasci (Schw.) Rehm, is found in North America and perhaps in Europe, with spores 20–30 × 8–12 μ, and *Hysterium praelongum* Schw. and *H. Lonicerae* Phill. & Hark. appear to be synonymous. *G. decipiens* de Notaris must be very similar.

G. connivens (Cooke & Hark.) Pazschke, from North America has spores 16–24 × 8–10 μ and may be distinct from *G. curvata* in somewhat wider, more obtuse spores.

6. *Glonium* Muehlenberg, is based on *G. stellatum* which occurs in North America on coniferous (and other?) substrata, and has spores 20–28 × 4–6 μ. *G. accumulatum* Schw. is synonymous. *Glonium* as delimited by von Höhnel includes only species with a definite subiculum; it has even been suggested by others that *G. stellatum* does not belong to the Hysteriales. *G. graphicum* (Fries) Duby has a less dense subiculum which may even be lacking; it occurs on conifers in Europe, and has spores 21–27 × 5–7 μ. For species of *Glonium* without subiculum von Höhnel proposed the sub-genus *Psiloglonium*, which Petrak (Ann.

Myc. **21**: 227) raised to generic rank. We have left the species below in *Glonium*.

G. parvulum (Gerard) Cooke, occurs in North America (and Europe?) on deciduous woody plants, and has small spores 6–8 × 2–3 μ. *Hysterium abbreviatum* Schw. and evidently *H. medium* Cooke, are synonymous.

G. nitidum Ellis, occurs on conifers in North America, and has non-constricted spores 6–13 × 2–3 μ. *Hysterium fibritectum* Schw. at Kew appears to be the same.

G. simulans Gerard, occurs in North America, and has spores 10–16 × 4–5 μ, slightly constricted.

G. lineare (Fries) de Not. occurs on deciduous woody plants in Europe and North America. It has spores 10–15 × 6–8 μ.

G. Cyrillae (Berk. & Curt.) Sacc. with which *Hysterium chlorinum* Berk. & Curt. is synonymous, is found on deciduous plants in North America. It has large spores, 54–82 × 13–17 μ.

7. *Hysterium* Tode ex Fries, has brown spores with cross septa. *H. pulicare* Pers. ex Fries occurs on deciduous woody plants in Europe, America, and elsewhere, and has spores 18–33×7–9 μ, 3 septate with end cells paler. *H. acerinum* West., *H. betulignum* Schw., and *H. truncatulum* Cooke & Peck are some of the synonyms; the *H. biforme* of Fries' Scler. Suec. seems to be the same.

H. acuminatum Fries, is the name applied to an alpine form on conifers in Europe with spores 13–16 × 5–6 μ.

H. angustatum Alb. & Schw. occurs on deciduous woody plants in Europe and America, with spores 15–22 × 5–7 μ, uniformly brown. *H. Eucalypti* Phill. & Hark. is the same.

H. insidens Schw. is found in North America, and probably in Europe, on deciduous (and coniferous?) plants, and has spores 24–40 × 6–10 μ, with one cell commonly larger than the others. *H. depressum* Berk. & Curt., *H. fusiger* Berk. & Curt., and perhaps *H. Berengerii* Sacc. are considered synonymous. Intergrading forms seem to invalidate any effort to distinguish two species here, based on length of spores.

H. thujarum Cooke & Peck, develops on conifers in North America, and has spores 30–40 × 10–14 μ.

H. macrosporum Peck, also occurs on conifers in North America, and has spores 40–57 × 11–15 μ.

H. magnosporum Gerard, has been collected on deciduous woody plants in North America, and has spores 50–65 × 15–20 μ.

8. *Hysterographium* Corda, has muriform brown spores. All the names in Ellis and Everhart (**2**), Rehm (**6**), and Massee (**5**), and one or two other names, are considered in this paper. The writer believes that these should be accounted for under the following eight names:

H. Mori (Schw.) Rehm, is a common species on deciduous and coniferous wood or bark in America and Europe, with spores 15–25 × 7–9 μ. The following appear to be the same: *Hysterium acuminatum* of Herb. Schw., *H. Gerardi* Cooke & Peck, *H. guaraniticum* of Balansa's Plants, *H. Lesquereuxii* Duby, *H. putaminum* Cooke, *H. Rousselii* de Not., *H. variabile* Cooke & Peck, *H. viticola* Cooke & Peck, and *Glonium hyalosporum* Gerard.

H. formosum (Cooke) Sacc. on alpine conifers in North America and probably in Europe, has spores 18–24 × 7–10 μ. *H. Pumilionis* Rehm is apparently the same. *H. formosum* is very close to, or possibly identical with, *H. Mori*, but may be distinct in possessing longer asci and somewhat smaller hysterothecia.

H. subrugosum (Cooke & Ellis) Sacc. occurs on *Quercus* in North America. The spores are 25–40 × 10–12 μ. *H. hiascens* Rehm and *H. kansense* Ellis & Ev. may be synonymous.

H. Rehmianum Sacc. is found in Europe on deciduous trees, with spores 30–40 × 12–14 μ. *H. naviculare* Karst. is possibly identical.

H. Fraxini (Pers. ex Fries) de Not. on ash, etc., is widespread The spores are 30–40 × 15–20 μ.

H. elongatum (Wahlenb.) Corda, is rare on *Salix* in Europe. The spores measure 30–45 × 10–15 μ.

H. nova-caesariense (Ellis) Roum. on *Pinus* in North America has spores 35–50 × 10–13 μ.

H. flexuosum (Schw.) Rehm, on deciduous woody plants in North America has the largest spores, 39–62 × 12–20 μ. *Hysterium Ceanothi* Phill. & Hark., *H. prominens* Phill. & Hark., *H. vulvatum* Schw., and *Lophium naviculare* of Herb. Schw. at Kew appear to be synonymous.

9. *Lophium*, with filiform spores and erect hysterothecia, is based on *L. mytilinum* (Pers.) Fries, which occurs on conifers in America and Europe; the spores are 120–150 × 1½–2 μ.

10. *Mytilidion* (*Mytilidium*) Duby, has upright hysterothecia and spores three or more celled. *M. tortile* (Schw.) Sacc. occurs on *Juniperus* in North America, with spores 12–16 × 4–5 μ. *M. decipiens* (Karst.) Sacc. is a similar or possibly identical species in Europe, but *M. tortile* as described by Rehm (**6**, p. 23) is another fungus with larger spores.

11. *Ostreion* (*Ostreium*) Duby, is based on *O. americanum*, which occurs in North America on *Liquidambar* and *Sassafras*, with spores 80–120 × 25–35 μ. *Lophium Sassafras* Schw. was found to be this species. *O. europaeum* Duby was found by Rehm (see **6**, p. 14) to be *Hysterium pulicare* form *pedicellatum*. *Ostreion* appears to differ from *Mytilidion* principally in the size of the spores, and the two names should probably be merged, as is done by Clements and Shear.

The following species were found by the writer, and in most cases by others previously, to be undeterminable, or to belong to other organisms than the Hysteriales: *Hysterium Azaleae* Schw., *H. confluens* Schw., *H. Kalmiae* Schw., *H. librincola* Schw., *H. nucicola* Schw., *H. rhois* Schw., *H. rugulosum* Schw., *H. Sambuci* of Herb. Schw., *H. stygium* Cooke, *H. Syringae* Schw., *H. sycnophilum* Cooke, *H. varium* Fries, and *H. vix-visibile* Gerard.

These names are still doubtful: *Tryblidium dealbatum* Gerard, *Hysterium cinerascens* Schw., *H. hiascens* Berk. & Curt., *H. hyalinum* Cooke & Peck, *H. ovatum* Cooke, and *Glonium Ravenelii* Cooke & Phil.

The writer is glad to acknowledge the kindness of the authorities in the Herbaria visited, and particularly that of the following mycologists: Miss E. M. Wakefield of Kew, Mr. J. Ramsbottom of the British Museum (Natural History), M. Roger Heim at Paris, Dr. Ulbrich of Berlin, Dr. E. J. Butler of the Imperial Mycological Institute, Kew, and Dr. H. D. House, State Botanist, Albany, New York. The writer would be glad to receive specimens or information from anyone interested in the Hysteriales.

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SOME SPECIES OF PLASMOPARA ON COMPOSITES FROM GUATEMALA

LEO CAMPBELL

(WITH 1 TEXT FIGURE)

In recent investigations of *Plasmopara* on composites from Guatemala and Illinois, the writer has observed a wide variation in the morphology in apparently the same species of *Plasmopara*. On different hosts, however, clearly discernible variations were found which appear to be sufficiently constant to warrant the separation of these fungi as distinct species.

Cross inoculation experiments will be undertaken with those of which fresh material is available. Only those from Guatemala, of which fresh material is not available for inoculation, will be considered here.

Up to the present time all specimens of *Plasmopara* reported on the Compositae have been called *Plasmopara Halstedii* (Farl.) Berl. & De Toni, with the exception of *Plasmopara Vernoniae-chinensis* Saw. established by Sawada on *Vernonia chinensis* Less. in Formosa in 1919 (**4**). Ellis preferred to call *Plasmopara* on *Ambrosia artemisiifolia* L., *P. Halstedii* var. *Ambrosiae* (**1**), and Toro, who reported a *Plasmopara* on *Bidens cynapiifolia* H. B. K., states it shows great variation from *P. Halstedii* ". . . especially with respect to the swelling of the branches. It is also unlike the other specimens on other hosts, in that the epispore is smooth instead of wrinkled" (**5**). Referring to *P. Halstedii*, Farlow states, ". . . we may expect to find it on almost any composite, although it apparently affects principally the Tubuliflorae" (**3**).

As yet *P. Halstedii* has been reported only on the Tubuliflorae, which is now commonly divided into two families, the Ambrosiaceae and the Corduaceae. Considering the large number of variable species of these two families, it may be expected that the *Plasmopara* parasitic on them might vary sufficiently from *P. Halstedii*, as originally described, to be separated from it as distinct species. Wilson (**6**) and others have expressed their

opinions that the species should perhaps be divided into several. This was the belief of Prof. Palm, who suggested this study.

The material from Guatemala was collected by Prof. Palm. *Plasmopara* were examined from some twenty specimens of composites of which only the following were specifically determined:

Gnaphalium purpureum L., San Rafael (6000 feet above sea level) near Guatemala City.

Bidens pilosa L., Guatemala City.

Erigeron scaposus D. C., San Rafael.

Spilanthes ocimifolia (Lam.) Moore, San Rafael.

Zinnia multiflora L., Amatitlan Lake.

Eupatorium areolare D. C., Antigua.

Galinsoga parviflora Cav., Guatemala City, San Rafael, and Antigua.

On all but *E. areolare* and *G. parviflora*, the specimens of *Plas-*

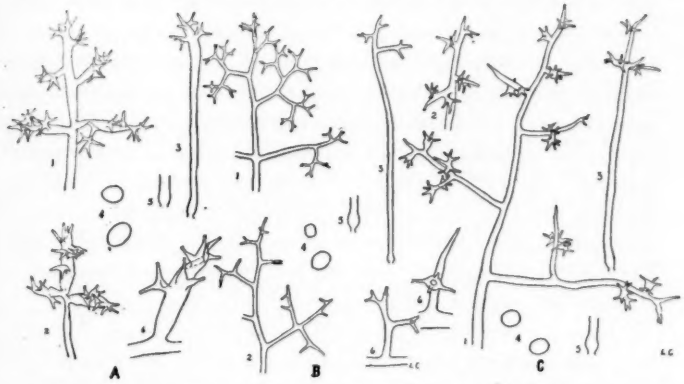

FIG. 1. A: *P. Palmii;* 1–2, Branching axes of conidiophores showing general characters; 3, Small conidiophore commonly found; 4, Two typical conidia; 5, Base of conidiophore showing slight enlargement; 6, Short branch of conidiophore enlarged to show detail. B: *P. Galinsogae;* 1–2, Branching axes of conidiophores showing general characters; 3, Small conidiophore commonly found; 4, Two typical conidia; 5, Base of conidiophore showing distinct enlargement; 6, Short branch of conidiophore enlarged to show detail. C: *P. Halstedii;* 1, Upper portion, and 2, entire branching axes of conidiophores, showing general characters; 3, Small conidiophore commonly found; 4, Two typical conidia; 5, Base of conidiophore showing distinct enlargement; 6, Short branch of conidiophore enlarged to show detail.

mopara were identified as *P. Halstedii*. Of the others, *E. scaposus*, *S. ocimifolia* and *Z. multiflora* have not previously been reported as hosts of *P. Halstedii*. They are here reported as additions to the host list of the pathogen; *S. ocimifolia* and *Z. multiflora* representing two new genera.

The *Plasmopara* on *E. areolare* caused distinct light-brown discolored spots on the leaves, but the fungus was somewhat inconspicuous due to the scanty production of conidiophores. It differed from *P. Halstedii* principally in the character of the conidiophores, the main axes of which tend to increase in diameter from the base to near the tip. The base of the conidiophores is relatively small and usually without the bulbous enlargement so common in *P. Halstedii*, and the branching axes are distinctly swollen; a character which readily distinguishes it from *P. Halstedii*. The dimensions of the conidia are greater, and the sterigmata are shorter and stouter than the sterigmata of *P. Halstedii* which often reaches a length of 36 μ.

The *Plasmopara* found on *G. parviflora*, in three different localities in Guatemala, produced light-brown discolored spots on the leaves where the fungus, due to the rather abundant production of conidiophores, was very evident. This fungus is readily distinguished from *P. Halstedii* by the tall, slender conidiophores. As in *P. Halstedii*, there is usually a distinct enlargement at the base, but, as with the other corresponding parts of the conidiophores, the diameter is much less than in *P. Halstedii*. The conidia are smaller, and the long sterigmata so common in *P. Halstedii*, are not to be found in this fungus.

The writer is of the opinion that the two new forms of *Plasmopara*, discussed above and characterized below, differ sufficiently from *P. Halstedii*, as originally described, to be of specific rank, and chooses to call the fungus on *E. areolare*, *Plasmopara Palmii*, and the one on *G. parviflora*, *Plasmopara Galinsogae*.

Specimens of each are deposited in the herbarium of the university of Illinois.

Plasmopara Palmii Campbell, sp. nov. on *Eupatorium areolare* D. C.

Hypophyllous, causing small light-brown discolored spots

covered with a scanty production of conidiophores; conidiophores robust, 2–6 times branched, 250–900 μ high; base usually without distinct enlargement, 8.5–17 μ broad; diameter immediately before first branch 9–17 μ; branching axes usually broader and characteristically swollen; first branch 2–5 times branched, 25–250 μ long, often swollen and club-shaped; conidia oval or elliptic, 12.5 × 24–24 × 40 μ; sterigmata stout, 3.5–17 μ long. No oöspores were found.

Hyphis hypophyllis, maculos subnigros facientibus; hyphis conidiophoris robustis, 2–6-ies ramosis, 250–900 μ altis, basi 8.5–17 μ latis, ante ramum primum 9–17 μ; ramo primo 25–250 μ longo; conidiis ovoideis ellipsoideis, 12.5 × 24–24 × 40 μ; sterigmatibus robustis; 3.5–17 μ longis; oösporis non visis.

Plasmopara Galinsogae Campbell, sp. nov. on *Galinsoga parviflora* Cav.

Hypophyllous, causing small light-brown discolored spots covered with conidiophores, usually appearing as white cottony mats; conidiophores slender, 3–8 times branched, 400–1000 μ high; base 5.5–12 μ broad; diameter immediately before first branch 5.5–10 μ; first branch 3–5 times branched, 150–400 μ long; conidia oval or elliptic, 8 × 8.5–17 × 20 μ; sterigmata slender, 3.5–17 μ long. No oöspores were found.

Hyphis hypophyllis, maculos subnigros facientibus; hyphis conidiophoris gracilibus 3–8-ies ramosis, 400–1000 μ altis, basi 5.5–12 μ latis, ante ramum primum 5.5–10 μ; ramo primo 150–400 μ longo; conidiis ovoideis ellipsoideis, 8 × 8.5–17 × 20 μ; sterigmatibus gracilibus, 3.5–17 μ longis; oösporis non visis.

The writer wishes to express his indebtedness to Prof. Bjorn Palm for having furnished the material, and for his efficient guidance in the completion of this work.

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NOTES ON BOLETES. I

WALTER H. SNELL

(WITH 1 TEXT FIGURE)

1. BOLETUS PORPHYROSPORUS

During the past two summers in the Adirondacks in New York, where the writer has been making persistent searches for boletes, a single plant was quite often found in one locality, which could not be identified with the help of American literature on the subject. This plant was noteworthy in three respects:— (1) the pileus and stipe were light olive brown to dark brown, turning black with age; (2) the spore print was a light reddish purple, quite different from the color of any described American species; (3) when spore prints were made on white paper, the paper was stained a bluish green. A search through European literature showed that it was a familiar Friesian species, *Boletus porphyrosporus* (FIG. 1). Thus far the writer has been able to find no mention of this species in America. There are no specimens of this species in the Farlow Herbarium at Harvard, but there is one at the New York Botanical Garden, which was sent by Bresadola.

The specimens obtained came from a single hollow in the Pack Forest operated by the New York College of Forestry near Warrensburg, N. Y. Continued collecting through the Adirondacks in similar forest stands has thus far revealed no other specimens. It would appear that this species is not generally distributed on this continent or even in this section of the country, and the material may possibly have been introduced with forest tree seed or seedlings which have been planted in the Forest. It so happens that only three plants were found in 1930 and several more in 1931 in the same hollow. This may mean that the species has just become established, although it should be kept in mind that the summer of 1930 was comparatively dry, while that of 1931 was very wet. On the other hand,

however, this portion of the Pack Forest is low and moist, and there was no lack of other fleshy fungi during 1930.

As an alternative to the foregoing, it is possible that this species has been found before but has been interpreted as another plant. *B. sordidus* was described by Frost from Vermont and has been reported from Ohio by Morgan. The distinguishing

FIG. 1. Sporophore of *Boletus porphyrosporus* Fries in Pack Forest, near Warrensburg, N. Y. The color of the pileus is not so light as it appears in this photograph, which was taken in dark woods with the light strongest from above. It would appear from this picture that the sporophore had been removed and stood up on top of the leaf litter, but such is not the case. The somewhat bulbous base was entirely above ground as shown here.

characteristics are given as a dirty-brown color of the pileus, the changing of the white flesh to reddish or greenish, a brownish stipe streaked, somewhat flexuous and striate, and large angular mouths of the pores. These characteristics are strongly suggestive of *B. porphyrosporus* in which the pores may become large and more or less angular in late maturity. The only differences between the two as can be pointed out are the smaller size of *B. sordidus*, its glabrous stipe, its yellowish-brown or dirty-brown spores without purplish tints, the slightly smaller size of the

spores and the failure to stain white paper when a print is made. The size of the spores of *B. sordidus* (10–12 μ long) falls within the limits of those of *B. porphyrosporus*, although most of the spores of the latter are 13–16 μ long. The only outstanding difference which could not come within the limits of the ordinary variations is the purplish tints of the spore prints of *B. porphyrosporus*. If spore prints were not examined when fresh, this difference might be overlooked. It therefore seems highly probable that *B. sordidus* is the same as *B. porphyrosporus*, which has priority.

If Fries' tribe Favosi (characterized by broad, angular tube mouths) is accepted, this species would be placed therein. It would be the only American species in this tribe unless *B. sordidus* is recognized as distinct. If one is hesitant in accepting this tribe, as was Peck, it would be placed in the Subtomentosi.

This account is presented for the purpose of bringing to light further information regarding the species if it has been found in this country before, and if not, in order to add it to the list of American boletes.

Specimens will be placed in the Farlow Herbarium at Harvard and in the Herbarium of the New York Botanical Garden. With the writer's collections at Brown University are also water color drawings.

The following description from the writer's specimens is added, inasmuch as it is more complete than can be obtained from European sources, except the recently published work by Kallenbach,[1] which contains excellent illustrations.

Pileus convex to plane, 5–11 cm. in diameter, 2–3 cm. thick.

Surface dry, subtomentose or minutely tomentose, smooth and soft like soft leather; in color, wood brown, buffy brown, deep olive buff, Saccardo's umber or dark olive buff,[2] becoming darker or blackish when handled; pellicle not separable.

Margin even, often rolling upward on drying.

Context firm, somewhat tough, white, slowly becoming tinged with red or reddish brown and occasionally purplish blue where cut or wounded; slightly farinaceous in taste; expressed sap staining white paper greenish or bluish-green.

[1] Kallenbach, Franz. Die Pilze Mitteleuropas. Band I. Die Röhrlinge (Boletaceae). Leipzig.

[2] Ridgway, Robert, Color Standards and Nomenclature.

Tubes adnate and usually slightly depressed around the stipe, ventricose, 10–15 mm. long; slowly changing to bluish green when exposed to the air and finally to reddish brown; mouths 7–8 to 5 mm., rounded to elliptical and sometimes slightly irregular, in color wood brown to tawny olive when young, with a tinge of olivaceous in places, becoming vandyke brown when old or where handled; edges entire.

Stipe central, tapering upward, sometimes uneven or ventricose, surface furfuraceous or minutely pulverulent under a lens, cortex cracking and rolling back or splitting in various ways (often in a zigzag manner); whitish to brownish, becoming dark brown or black where handled or with age; solid, whitish within but sometimes brown at the base, turning black with age; 6–15 cm. long, 1–2.5 cm. thick.

Spores in mass light purple drab when fresh and light cinnamon drab when older; white paper on which spore print is made is usually stained greenish or bluish green from the sap which escapes from the context through the tubes; elliptical to elliptical-fusiform, with porphyry reddish epispore and greenish center, 10.5–20.5 × 5.3–6.5 (mostly 13–16 × 5.5–6 μ, with only a few of the extreme length of 19 or 20 μ).

Odor not conspicuous, although somewhat unpleasant at times. Occurring singly in low moist area under mixed hardwood and conifer stand (especially hemlocks); July to September 16th. Pack Forest, Warrensburg, N. Y.

Illustrations: Michael-Schulz. Führer für Pilzefreunde 1: 283. 1927

Kallenbach, Franz. Die Pilze Mitteleuropas Band I. Die Röhrliche (Boletaceae). Lieferung 10, Taf. 26. 1930

The tubes of this species are not as angular as described by Michael and Kallenbach, the odor is not so unpleasant or musty, the spores are rarely as long or as broad, and the edges of the tubes are not jagged as given by Kallenbach. Otherwise, the descriptions by these German writers fit our specimens.

BOLETUS LUTEUS AND BOLETUS SUBLUTEUS

There has been much confusion over these species in this country. Peck reported the former as rare in New York and described *B. subluteus* as differing from *B. luteus* by "its smaller size, more slender stem and glutinous collapsing veil" and being glandular dotted both above and below the annulus, whereas the latter was dotted only above the annulus. Murrill united these two species (N. Am. Fl. 9: 155) under the name *B. luteus* and described the stipe as being glandular dotted above and below the annulus. Peck in the above mentioned bulletin, said of *B. luteus* that "in some specimens the annulus appears to sheath the lower part of the stem," although in an earlier publication he stated that this was a common feature. Murrill says nothing of this in any place that the writer can find, although his upper right hand figure of a young plant on plate 2 in volume 12 of MYCOLOGIA (opp. p. 59) apparently faintly shows what appears to be a veil sheathing the stem.

These discrepancies have left a student in confusion, especially inasmuch as the writer has continually found a few specimens of what appears to be *B. luteus* in a Scots pine plantation near Minerva, N. Y. The pileus of these was a deep chestnut in color, the stipe was glandular dotted both above and below the annulus, with a conspicuous sheath of the stem which became shredded as the plants grew in size, and with the upper part of the stem reticulate from the decurrent walls of the tubes in most specimens. This latter feature has been mentioned by neither Peck nor Murrill as far as can be found.

Kallenbach's recent description (p. 45) notes all these features and is very satisfying. He likewise included *B. subluteus* Peck in *B. luteus* Fries. This may be the proper disposition of Peck's *B. subluteus*, although in justice to Peck's mycological acumen, it may be said that the writer has found this form, readily distinguishable by the characters mentioned by Peck (see above), as one of the four most common boletes in the Adirondacks—the others being *B. granulatus* L., *B. scaber* Fries and *Boletinus pictus* Peck. The form which he calls *B. subluteus* can be found all summer in any season under white pine growth. The writer

has never found it with a sheathing veil and is inclined to consider it a distinct species as maintained by Peck.

BOLETINUS SPECTABILIS

This species was first found by Peck near North Elba, in the Adirondacks, and was placed in the genus *Boletus*. He later collected the same species near Indian Lake. In connection with these specimens he said that this species with *Boletinus pictus* and *B. paluster* formed a natural group of allied species, yet he left it in the genus *Boletus*. In his monograph, also, he left it in *Boletus*. Murrill changed it to the genus *Boletinus*, as *Boletinus spectabilis* (Peck) Murrill.

This change seems to be a reasonable one. The writer collected these plants several times between Indian Lake and Blue Mt. Lake during the past summer and all of them showed to some extent at least, the *Boletinus* characters. In some of them the tubes were definitely arranged in a radiating manner, and veining was common. In other plants there was only a suggestion of radiating tubes and veining. On the other hand, in specimens collected near Warrensburg, N. Y., late in the fall, these characters were hardly discernible at all. It may be said, however, that many specimens of *Boletinus pictus* can be found which show no veining even in young forms, although the tubes are of the *Boletinus* type.

In view of the apparent relationship of these three species and the usual presence of the necessary characters, it seems best to follow Murrill's change.

CERTAIN LARICOPHILOUS SPECIES OF BOLETUS

There has been considerable difficulty with most of the Boletes found growing under or near larch trees. There seems to be no question about the specificity of *Boletinus spectabilis* and *B. cavipes*. The writer has had no difficulty with *Boletus Clintonianus* in the Adirondacks, although Kallenbach would reduce this name to synonomy. On the other hand, one has difficulty with certain of the other species. Peck has recognized *B. laricinus* Berk. and named *B. elbensis*. Frost named *B. serotinus*, which Peck said was probably a variety of *B. elbensis*.

Murrill (N. Am. Fl. **9**: 156) remarked that *B. elbensis* Peck appeared to be *Boletinus glandulosus* Peck, which was probably the same as *Boletus aeruginascens* Secr. and which is a synonym of *B. viscidus* Fries (not *B. viscidus* L.).

Kallenbach has removed *B. Clintonianus* Peck from this tangle by making it a synonym of *B. flavus* Fries ex With. which he prefers to call *B. elegans* Fries (not Schum.). He has then made *B. aeruginascens* Secr., *B. laricinus* Berk., *B. serotinus* Frost and *Boletinus grisellus* Peck synonyms of *B. viscidus* Fries.

The writer is not qualified to pass upon the change with regard to *B. Clintonianus*, because there seems to be some question with regard to the occurrence of the form called *B. flavus* Fries ex With. (or *B. elegans* Fries) in this country. Likewise, the writer cannot pass upon *Boletinus grisellus*, which is given as found only once near Natick, Mass., although it must be said that Peck's description fits that of Kallenbach for *B. viscidus*. Peck placed the species *grisellus* in *Boletinus*, although he said nothing about the tubes and veins.

With regard to the other laricophilous species, it has been very difficult to make collections of large numbers of these plants found under larch trees in Peck's own localities fit the descriptions of any one of *B. laricinus*, *B. elbensis*, *B. serotinus* or *B. grisellus*. Individuals of any one collection from the same spot could be put in different ones of the four. Therefore, the grouping of these along with *B. aeruginascens* under *B. viscidus* Fries seems at present to be a satisfactory treatment.

BOLETUS RHODOXANTHUS

A plant has been collected occasionally in the Adirondacks which it has been difficult to identify. It is apparently near to *B. purpureus* Fries of the Luridi, although its tubes do not always have red mouths. There has been some difference of opinion with regard to the occurrence of *B. purpureus* in this country. Peck cites collections of it from North Carolina, Minnesota, and New York, but Murrill did not recognize the species. Kallenbach has split *B. purpureus* into *B. rhodoxanthus* (Krombh.) Kallenb. and *B. erythropus* Pers. (not Fries). The writer feels that this rearrangement will aid in the proper placing of the species formerly hard to identify as *B. purpureus*.

Our plants seem closely to fit the description of *B. rhodoxanthus*. It was found in July and August in hardwood stands of oak, beech, and maple near South New Berlin, N. Y. Before definitely placing this in the list of American species, however, the writer prefers to await study of additional collections. In the meantime it is hoped that this announcement may ellicit further information upon forms formerly placed in *B. purpureus*.

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SOME LICHENS OF OREGON[1]

V. GYELNIK

In December, 1930, I received some lichens from F. P. Sipe, Corvallis, Oregon. These were sent me in response to a request for material of the genera *Alectoria*, *Peltigera*, and *Nephroma*, which I am revising. The material received is of sufficient interest to justify publishing it. Part of each specimen listed is deposited in my herbarium, and part in the herbarium of Oregon State Agricultural College, at Corvallis. Except where otherwise stated, the lichens have been collected by F. P. Sipe.

1. PELTIGERA CANINA (L.) Willd. f. SPONGIOSA Tuck.
   Along roadside, on soil, Corvallis, Benton County.
2. P. CANINA (L.) Willd var. RUFESCENS (Weis.) Willd.
   On shallow soil, Union Creek, Jackson County.
3. P. DOLICHORRHIZA Nyl.
   At base of tree, Swim, Clackamas County, and on soil, Waldport, Lincoln County.
4. P. HAZSLINSZKYI Gyel.
   On soil, near Mt. Hood, Clackamas County.
5. P. MEMBRANACEA (Ach.) Nyl. f. PELLUCIDOIDES Gyel.
   On moist shaded stream bank, Mt. Hood, Clackamas County.
6. P. MEMBRANACEA (Ach.) Nyl. f. SZATALAE Gyel.
   On soil, Waldport, Lincoln County.
7. P. MEMBRANACEA (Ach.) Nyl. f. FIBRILLOIDES Gyel.
   On moss, Triangle Lake, Lane County.
8. P. POLYDACTYLA (Neck.) Hoffm.
   On fallen logs, Breitenbush, Marion County.
9. P. POLYDACTYLA (Neck.) Hoffm. var. SUBNERVOSA Gyel.
   On fallen log, Rhododendron, Clackamas County.
10. P. PRAETEXTATA (Floerk.) Zopf. var. SUBCANINA Gyel.
    On decaying stump, Corvallis, Benton County, and on moss, Union Creek, Jackson County.

[1] This paper has been emended in respect to collection data and edited by F. P. Sipe for publication in MYCOLOGIA.

11. P. SCUTATA (Dicks.) Leight. var. COLLINA (Ach.) Gyel.
    On soil, Mt. Hood, Clackamas County.
12. P. VARIOLOSA (Mass.) Gyel.
    On rocks, Union Creek, Jackson County, and on trees, Rhododendron, Clackamas County.
13. P. VARIOLOSA (Mass.) Gyel. f. CRISPA (Vain.) Gyel.
    On soil, Waldport, Lincoln County.
14. P. VARIOLOSA (Mass.) Gyel. var. *dactylodes* (Nyl.) Gyel.
    On soil, near Mt. Hood, Clackamas County.
15. P. VARIOLOSA (Mass.) Gyel. f. BRITANNICA Gyel.
    On trees, near Rhododendron, Clackamas County.
16. P. VENOSA (L.) Baumg.
    On soil, near Mt. Hood, Clackamas County.
17. ALECTORIA SARMENTOSA Ach.[2]
    On conifers, near Mt. Hood, Clackamas County.
18. NEPHROMA RESUPINATUM (L.) Ach. var. HELVUM Mass.
    On willow trees, near Mt. Hood, Clackamas County, and on maple, Breitenbush, Marion County.
19. N. RESUPINATUM (L.) Ach. f. GRISESCENS Gyel.
    On dead tree, near Rhododendron, Clackamas County.
20. N. RESUPINATUM (L.) Ach. f. RAMEUM Schaer.
    On maple, near Mt. Hood, Clackamas County.
21. **N. resupinatum** (L.) Ach. f. **inaequalis** Gyelnik forma nov.[3]
    On alder, Union Creek, Jackson County.
22. N. TROPICUM (Müll. Agr.) Zahlbr.
    On maple, Breitenbush, Marion County.
23. **N. Sipeanum** Gyelnik sp. nov.[4]

This species differs from *N. Schultz-Korthii* Gyel. in having the thallus at the back of the apothecia isidiate, the apothecia subentire at the margins, and not proliferous. *Thallus* glabrous above, smooth, isidiose; margin proliferous, fimbriately isidiose;

[2] Thallus K−, C−, KC+ flavus demum lente rubescens. Fert.−.

[3] Similis var. *helvo* Mass. sed thallus subtus sat venosorugosus.

[4] **Nephroma Sipeanum** sp. nov. A *Nephroma Schultz-Korthii* Gyel. different thallo in dorsis apotheciorum isidiato, apotheciis ad margines subintegris, non proliferis. Thallus superne glaber, levis, isidiosus, ad marginem proliferus (fimbriato-isidiosus) in dorsis apotheciorum pubescens et isidiosus, subtus tomentellus, epapillosus. Margines thallini apotheciorum subintegri. Medulla alba, K—, KC+ flava.

apothecia pubescent and isidiose at the back, tomentulose without papillae below. The small thalli of the apothecia have subentire margins. Medulla white, K−, KC+ yellow. Spores fusiform to ellipsoid, unilateral, 3-septate, guttulate, brown, 21–25 × 6–8 μ.

On oak tree, Eagle Point, Jackson County. Collected by L. N. Goodding.

N. Sipeanum is named in honor of Prof. Frank P. Sipe, Corvallis, Oregon.

24. N. PARILE Ach. f. HYBRIDUM Gyel.
    On *Rhododendron*, Breitenbush, Marion County.
25. N. FILARSZKYANUM Gyel. f. EUVULGARE Gyel.[5]
    On ash tree, Corvallis, Benton County.
26. N. LUSITANICUM Schaer.
    On ash tree, Corvallis, Benton County.

MAGYAR NEMZETI MUSEUM NOVENYTANI OSTALYA,
BUDAPEST, HUNGARY

[5] Medulla alba, K−, KC−.

THE SEXUAL FUNCTION OF THE MICROCONIDIA IN CERTAIN DISCOMYCETES[1]

F. L. Drayton

During the past century, frequent references have been made to structures in some of the Discomycetes which have been either termed microconidia or spermatia. Speculation has been rife as to their function. Like the pycniospores of the rusts, these bodies were relegated to the ephemeral realm of functionless male cells, problematic true spores, and the like. Failure to establish the true rôle of these bodies is the more remarkable, since the sexual function of structures homologous with the microconidia has been generally accepted for certain of the discomycetous lichens, and for some of the Laboulbeniales. Tulasne, who was the first to describe these bodies in the Discomycetes,[2] designated them as spermatia or conidiola" . . . believing that sometime or other it would be demonstrated that there resided in them a certain force or nature like that of pollen."[3] In spite of the disconcerting evidence that many minute conidia, morphologically indistinguishable from the conidiola of the Discomycetes, germinate and reproduce the fungus, Tulasne apparently never entirely abandoned the belief that these nongerminating conidiola function, like the spermatia of the lichens, as male sperms. Whetzel,[4] in discussing the microconidia of *Sclerotinia Duriaeana* (Tul.) Rehm, suspected the true rôle of these bodies when he states, "They more probably function as do the spermatia of the rusts"; and this is here shown to be the case.

In the descriptions of many species, especially those of *Sclerotinia* and *Botrytis*, microconidia have been well characterized. Briefly, they are globose, 2–4 μ in diameter, and are produced

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[2] Tulasne, L. R. & C. Selecta Fungorum Carpologia (Transl.) **3**: 183.

[3] Ibid. **1**: 183.

[4] Whetzel, H. H. North American species of Sclerotinia II. Two species on Carex, S. Duriaeana (Tul.) Rehm, and S. longisclerotialis n. sp. Mycologia **21**: 5–32. 1929.

successively from small, fasciculate, Indian-club-shaped conidiophores, arising from a single hyphal cell. The microconidia are produced in large numbers in each cluster and are embedded in a mucilaginous matrix which on drying becomes waxy. Most investigators, including the writer, have failed to obtain any appreciable growth through the germination of microconidia. The few cases where such successful germination is reported, remain to be satisfactorily explained.

In the course of a taxonomic study of a number of sclerotium-producing fungi affecting bulbous and cormous ornamentals, the development of apothecia by *Sclerotium Gladioli* Massey [5] has been induced by means of placing the microconidia of one thallus on certain structures which develop on another thallus. This process may be called "spermatization," and it will be so designated throughout this paper. The ascospores obtained from these apothecia have been cultured and the resulting growth is identical in every respect with that of the original cultures. These fruiting bodies are typical of those found in *Sclerotinia*, and this fungus must now be placed in that genus.

Seven isolates of *S. Gladioli* were used, four from the garden gladiolus, one from a variety of the *Gladiolus nanus* type, one from crocus, and one from freesia. Clonal cultures were obtained by single hyphal tip isolations, and the identity of every isolate established by successful inoculation of gladiolus corms.

On transferring these isolates to suitable culture media, and subjecting them to proper conditions of moisture and temperature, a discontinuous layer of sclerotized tissue, along with scattered sclerotia, are formed over the surface of the substratum. From this crust receptive bodies develop which are variously shaped, but more or less columnar, about 1 mm. in height, brown or light brown, and covered with short protruding hyphae. These structures, when spermatized with microconidia from a reactive isolate, and subjected to proper conditions of temperature and moisture, promptly develop into apothecial fundaments, and on exposure to light, expand into mature apothecia. Receptive bodies, treated identically, but on which no microconidia

[5] Massey, L. M. Dry rot of gladiolus corms. Phytopathology **18**: 519–529. 1928.

were placed, or spermatized with a non-reactive isolate, proliferate to some extent, and may attain a height of 3 mm., but never develop into apothecia. After many modifications of the technique, it is now possible to obtain mature apothecia in 6–7 weeks from the time when the clonal culture is transferred to the substratum employed.

Some 127 such spermatizations have been made, using the receptive bodies and microconidia of the seven isolates in all possible crosses. In addition, about a fourth that number of cultures has been used as checks. It was discovered that only one of the seven isolates is of opposite reactive potentiality to the others. That is, apothecia are produced only when the isolate from crocus is used as a source of microconidia to spermatize any of the other six, or when the microconidia from any of the other six are used to spermatize the receptive bodies of the crocus isolate. It was also demonstrated that the receptive bodies of each isolate do not react with their own microconidia; that is, they are all self-sterile.

We therefore have here two strains or races, one represented by the isolate from crocus, the other represented by the remaining six isolates. These two races represented in the present collection of seven isolates are reciprocally interfertile, the six isolates representing one race are reciprocally intersterile. All isolates in both races are self-sterile.

Thus *S. Gladioli* presents in this respect essentially what Craigie has found to be the situation in the rusts. The sexual mechanism is strikingly different from that reported in the higher Basidiomycetes by Buller and his co-workers, and by Dowding [6] in *Ascobolus*, in that diploidization apparently does not result from vegetative fusion. This was demonstrated by the use of paired cultures, employing pairs of interfertile isolates. Under optimum conditions, no apothecia developed as a result of the intermingling of the hyphae of the two thalli, even though receptive bodies were abundantly produced by each isolate. Upon cross-spermatization, however, apothecia promptly devel-

[6] Dowding, E. Silver. The sexuality of *Ascobolus stercorarius* and the transportation of the oidia by mites and flies. Annals of Botany **45**: 621–637 1931.

oped. Paired cultures of intersterile isolates gave no apothecia, even of course when cross-spermatized.

It is highly probable that this sexual mechanism is operative, with perhaps slight modifications, in all of the spermatia-producing Ascomycetes, including in the term spermatia, microconidia of the type here described.

Certain phases of the cytological aspect of this problem are being undertaken, and it is expected that in the near future a more comprehensive paper will be published dealing with the technique employed, and a more detailed description of the structures concerned.

This investigation has been conducted under the direction of Professor H. H. Whetzel. The valuable suggestions and stimulating encouragement given by him, and also by Professor L. M. Massey are gratefully acknowledged.

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NOTES AND BRIEF ARTICLES

On January 23, 1932, Joens Elias Fries died at Birmingham, Alabama. He was born in Sweden in 1877 and educated in the University of Stockholm, coming to the United States in 1903, as an electrical engineer. Although he was not a professional mycologist he had been a subscriber to MYCOLOGIA for a number of years and prepared two fungus charts, copies of which are on file in the library of The New York Botanical Garden.

THE CLASSIFICATION OF PYTHIUM

Mr. Sideris has recently granted [1] the correctness of my contention [2] that *Nematosporangium* has no standing taxonomically [3] and hence, the matter of what shall be called *Pythium* becomes a subject, not for individual apologetics but for the committee on *nomina conservanda*.

Concerning his statement that I did not read very carefully the description of *Pythium monospermum*, the type species of the genus, or else I would have noticed that ". . . the hyphae of this organism possessed bud-like outgrowths which came to be known by later investigators as prosporangia," and further, that "the German text in connection with the lobulate prosporangia of *P. monospermum* reads as follows: '. . . Fäden oft mit vielen Kurzen annähernd rechtwinkelig ansetzenden Seitenästen . . .'," allow me to say the following:

I carefully perused Pringsheim's [4] description of his fungus but could find no such statement. Further search, however,

[1] Science **74**: 596, 1931.

[2] Science **73**: 41, 1931.

[3] Brussels Code, Sect. 6, Art. 45, p. 44. "When a genus is divided into two or more genera, the name must be kept and given to one of the principal divisions. If the genus contains a section or some other division, which judging by its name or its species, is the type or the origin of the group, the name is reserved for that part of it." . . .

[4] Jahrb. Wiss. Bot. **1**: 284, 1858.

revealed in *Fischer*[5] the following: "Mycelium saprophytisch auf im Wasser faulenden Fliegen und Mehlwürmern, bildet 1.5–2 cm. breite Rasen von *Saprolegnia*-habitus, mit zarten, 2–5 μ breiten, sehr langen und verästelten Faden, oft mit vielen kurzen, annähernd etc. . . ." Mr. Sideris's quotation is *not*, therefore, as one might suppose, from the original source, Pringsheim, but from Fischer, and further, the latter writer's text was not "in connection with the lobulate prosporangia of *P. monospermum* . . . ," but the *mycelium*. Nowhere in Pringsheim was I able to find evidences of inflated portions of the mycelium being evacuated through a filamentous discharge tube. Furthermore, if Pringsheim's figures of the sporangia be examined (PL. 21, FIG. 13)—and from so keen an observer they can hardly be considered atypical ones—not even a suggestion of inflated elements can be found. Finally, irregularities of the mycelium need not necessarily always be concerned—as the writer recently has shown [6]—with sporangial activity, and Mr. Sideris's assumption that Fischer's account of the mycelium of Pringsheim's species contains references to prosporangia seems unwarranted by the evidence at hand.

For the above reasons, I am forced to adhere to my original contention, namely, (1) that *Pringsheim's* fungus possessed entirely filamentous sporangia; (2) as it (*P. monospermum*) is the type species of the genus, if *Pythium* in its inclusive sense is to be split, there is at present no taxonomic justification for *Nematosporangium;* (3) some name must be given the lobulate and sphaerosporangial forms other than *Nematosporangium* and *Pythium*.

The astonishment evinced by Mr. Sideris with respect to the establishment of *Rheosporangium* (in spite of the existence of other well established, closely related forms then classed in *Pythium*) seems to indicate that he has not read the statement by the author [7] (p. 289) of that genus, that the latter was moved to erect it because he found no related organisms described in Minden [8]—a work which does not include the Peronosporaceae,

[5] Kryptogamenfl. Deutsch. etc. 1[4]: 399, 1892.
[6] Mycologia 23: 191, 1931.
[7] Journ. Agr. Res. 4: 279, 1915.
[8] Kryptogamenfl. Mark Brandenburg 5: 209, 1915.

of which *Pythium* is a member. The fact remains however, that *Rheosporangium* appears to be the first valid genus name applied to a lobulate species of *Pythium*.

In closing his reply to my suggested treatment of *Pythium*, Mr. Sideris answers my criticism of his failure to separate filamentous and lobulate sporangial forms with the statement that he has ". . . never seen any species of *Nematosporangium* (*P. monospermum* type of organisms) lacking the lobulate prosporangia. . . . These bodies vary in size and number in different species, but they are present, nevertheless, in all species." And also, if my proposal were followed (in placing lobulate forms in *Rheosporangium*, etc.), there ". . . would not be left any more members for *Pythium*." No doubt Mr. Sideris has not observed species with entirely filamentous sporangia, but he need only to consult the figures of sporangia given by Pringsheim, Schenk, Ward, Gobi, Raciborski, de Wildemann, Kanouse and Humphrey, Matthews, Sparrow, etc., to see a number of them portrayed. There seems little danger of the extinction of *Pythium* if the latter genus is restricted to entirely filamentous sporangial forms so long as the following organisms are known to science: *Pythium monospermum* (of Prings.), *P. tenue* Gobi, *P. dictyosporum* Racib., *P. gracile* Schenk (sensu lat. Matthews), *P. perniciosum* (in part), *P. daphnidarum* Pet., *P. afertile* K. & H., *P. papillatum* Matt., *P. angustatum* Spar., *P. adhaerens* Spar.

In closing, let me say that my original idea in criticising Mr. Sideris's classification was not for the purpose of proposing one of my own. Adhering to this idea, I made no new combinations which would validate it. I do not believe that sharp lines of demarkation delimit groups here any more than they do in other classes of organisms. I did intend, however, to bring to the attention of mycologists and pathologists the anomalous situation extant with respect to the usage of the generic names *Nematosporangium* and *Pythium*.

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THE TYPE OF PESTALOTIA

In the Genera of Fungi, p. 384, Clements and Shear cited *Pestalotia funerea* Desm. as the type of the genus and in the same line cited De Notaris (1839) as the author of the genus. What a strange coincidence! *P. pezizoides* De Notaris (1839) is the original species, *P. Guepini* Desm. (1840) the second and *P. funerea* Desm. (1843) the third in the order of publication. An inquiry to Dr. Shear to learn his reason for selecting *P. funerea* Desm. instead of *P. pezizoides* De Notaris brought forth the reply that "according to the revised rules the type of a genus should be a common or well known species which will fix the generic name according to general usage." "That is the reason we selected *P. funerea* instead of *P. pezizoides*." All three species are common and well understood, the first two much more so than the third if one wishes to accept as a criterion the number of and the determination of the specimens in the various exsiccatae sets of fungi. The name *P. funerea* Desm. has been applied to almost everything and has been very much misunderstood and misused. This, however, is no criticism of its use for the purpose stated by Shear.

The genus *Pestalotia* was monotypic when first described. The original species *must absolutely remain the type species*. Even though the type species had never again been collected it must still remain the type. The strictest respect for this rule is very important if we hope to maintain a healthy state of affairs in systematic mycology.

E. F. GUBA